Voyager 5000 SCSI RAID Storage Users Manual

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Scope

This manual details the installation and configuration of the Voyager 5000 Storage Array. It describes the standard and high availability configurations. System configuration using the monitor utility menu options is also described.

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Chapter 1:
Introduction 1-1

Features 1-1

The Voyager 5000 Family 1-2

- Voyager 5000 Data Warehouse Models 1-3
- Voyager 5000 Rackmountable Models 1-4
- VRA-5003D-XX-Y 1-5
- VRA-5005D-XX-Y 1-6
- VRA-5006D-XX-Y 1-7

High Availability Systems Configuration Details 1-8

- Detailed High Availability Single Host Example 1-8
- Detailed High Availability Dual Host Example 1-9
- VRA-5003DHA-XX-Y 1-9
- VRA-5005DHA-XX-Y 1-11
- VRA-5006DHA-XX-Y 1-12

Voyager 5000 Options 1-13

- Cache Options 1-13
- Host Cards 1-13
- Expansion 1-13
- Rackmount Cabinets 1-14
- Vision Software 1-14

Design 1-14

The Need for RAID 1-15

- What is RAID? 1-15

Custom Components 1-16

- XOR ASIC 1-16
- DMA ASIC 1-16
- CPU Interface ASIC 1-16
- Memory Controller ASIC 1-16
- Efficient Write and Read Algorithms 1-17

Write-Back Caching 1-17

- Write Gathering 1-17

Write On Top 1-18

RAID Levels Supported 1-18

RAID 0 1-18

RAID 1 1-19

RAID 0+1 1-20

RAID 4 1-22

RAID 5 1-23

**Chapter 2:
Voyager 5000 Basic Components 2-1**

Shelf Type 2-1

Controller Shelf Components 2-2

Accessing the Controller 2-3

Connecting DC Power to Controllers 2-4

External Connectors 2-6

Serial Port Connectors 2-6

UPS Connector 2-6

EMU Connector 2-7

AC Power 2-7

Removing RAID Controller from the Controller Shelf. 2-7

Voyager 5000 Controller 2-8

Controller Connectors 2-8

System Power 2-8

Term Power 2-9

Battery 2-9

Uninterruptible Power Supply (UPS) 2-10

Failover Connector 2-10

External Temperature Sensor and UPS Signal Connector 2-10

Warning Alarm 2-11

Disk Drives 2-12

Inter-Integrated Circuit (I2C) Connector 2-12

UART Connector 2-13

Test Port 2-14

External Alarm 2-14

    Cache 2-14
    How To Order SIMMs 2-14
    Installing SIMMs 2-15
    Installing Modules 2-16
    How to Tell Modules Apart 2-17
    Controller Fan 2-19
    The Power Supply 2-19
    Device Carrier 2-20
    SCA Attachment 2-20
    Non SCA Attachment 2-21
Power Options Board 2-22

Advanced Cooling Modules 2-23

Chapter 3:
Environmental Monitoring Unit 3-1

Introduction 3-1

EMU Features 3-1

System Configurations 3-2

Setting up the EMU 3-3

Available EMU Information 3-6

Interpreting the EMU LED Feedback 3-8

Connecting the EMU 3-8

Chapter 4:
Installation and Upgrade 4-1

Unpacking and Initial Setup 4-1

Recommendations for Installation of Voyager Rackmount systems in Standard 19" Racks 4-1

    Ambient Temperature 4-2
    Air Flow 4-2
    Mechanical Loading 4-2
Electrical Considerations 4-2

- Circuit Overloading 4-2
- Grounding 4-3

Setting the SCSI IDs 4-4

Drive Geometry 4-8

Cabling and Termination Issues 4-8

- Host Cabling 4-8
- Shelf Cabling for Single Bus Configuration 4-9
- Shelf Cabling for Dual Bus Configuration 4-10

Voyager 5000 Standard Configuration 4-14

- VRA-5003D-XX-Y 4-14
- VRA-5005D-XX-Y 4-16
- VRA-5006D-XX-Y 4-18
- Multiple Host Configurations 4-20

Chapter 5:
Monitor Utility 5-1

Connecting a Monitor 5-1

- Emulating a Monitor 5-1

Monitor Utility 5-5

- Navigating the Menu Tree 5-6

RAID Information 5-7

Setup Parameters 5-8

- Host Parameters 5-8
- System Parameters 5-10
- Host LUN Mapping 5-13
- Caching Parameters 5-13
- Disk Parameters 5-14
- Transfer Mode 5-15
- Channel Settings 5-15
- Redundant Controller Parameters 5-16

System Information 5-16

- I/O Statistics 5-17
- Free List Statistics 5-17

  - Manufacturing Information 5-18
  - Environmental Status 5-19
  - Transfer Rate Information 5-19
  - I/O Process Information 5-20
  - Rdnt Ctrlr Information 5-20
- RAID Set Functions 5-21
- How to Create a RAID Set 5-21
  - RAID Set 5-22
  - RAID Level 5-22
  - Drive Selection 5-22
  - Partitions 5-22
  - Drive Info 5-22
  - Redundancy Group Number 5-24
  - Chunk Size 5-24
- Rebuild Disk 5-25
- Add Spare Drive 5-26
  - Hot Spare 5-27
  - Warm Spare 5-27
- System Functions 5-28
  - Change Password 5-28
  - If you Forget Your Password 5-29
- Load System Code 5-29
  - Restart System 5-30
  - System Shutdown 5-30
- Disk Utilities 5-30
  - Format Disk 5-31
  - Test Disk 5-32
- Rebuild/Create Status 5-32
- Event Log 5-33
  - All Recorded Events 5-35
  - Starting Sequence Number 5-35
  - Starting Date and Time 5-35

Event Type 5-35
RAID Set Number 5-37
Disk I/O Channel 5-37
Disk I/O Channel and SCSI ID 5-37

Chapter 6:
High Availability Configurations 6-1

Introduction 6-1

Requirements 6-1

SIMM Installation 6-2

RCC Cable Connection 6-3

Single-Host Configuration Examples 6-4

Single-Host Active/Active Configuration 6-4
Cabling the Single Host Active/Active Configuration .. 6-5
Single Host Active/Passive Configuration 6-7
Multiple Host Configuration 6-7
Cabling the Dual Host Active/Active Configuration 6-8
Cabling the Dual Port/Dual Host Active/Active Configuration 6-9

Setting the SCSI ID on Fault Tolerant Voyager 5000 6-10

Configuring Redundant Controller Operation 6-13

Setting Node Names and Active/Passive Designations 6-13
Setting Disk Parameters 6-14
Setting Host Parameters 6-15
Host LUN Mapping 6-16
Viewing Controller Information 6-19

Restart After Switchover 6-20

Chapter 7:
Front Panel Operation 7-1

Main Menu 7-1

RAID Set Status 7-1
Shutdown System 7-2
Front Panel Tests 7-2

Set LCD Contrast.. 7-2
Alarm Test 7-2
Key Switch Test 7-2
Pixel Test 7-3
Rebuild Select 7-3
Rebuild Status 7-4
Add Spare 7-4
Hot Spare 7-5

Warm Spare.. 7-5

Chapter 8:
Battery Backup and UPS.. 8-1

Uninterruptible Power Supply (UPS) 8-1

When the AC Input to the UPS Fails 8-1
When There is Only Two Minutes of UPS Reserve Power Left.. 8-2
Connecting to a Non Eurologic Supplied UPS............. 8-2
UPS Pin Contacts... 8-2
Shutting Down the System 8-2
Battery Backup.. 8-3

SIMMs and Battery Precautions.................................. 8-3
Powering down the Voyager 5000 for Extended Periods...... 8-3

Battery Capacity 8-4
UPS Connector Pin Assignments 8-5

Chapter 1: Introduction

This manual provides instructions on how to install, configure and use the Voyager 5000 Storage Array. There is step by step instructions that will help you get your Voyager 5000 up and running. Other Chapters go into greater detail on other features of the unit and possible configuration alternatives. For those of you who are new to RAID, this chapter also presents a quick overview of the concept.

Features

The main features of the Voyager 5000 Storage Array include:

- User selectable RAID 0, 0+1, 4 or 5 operational modes as well as discrete drive operation (JBOD).
- Up to 7 parallel SCSI disk channels.
- Up to 42 total SCSI disks per Voyager 5000.
- Disk drives are NOT required to be from the same manufacturer.
- Designed to support Fault Tolerant subsystem configurations.
- Extremely high data efficiency due to wider drive array configurations.
- Supports concurrent RAID 0, 1, 0+1, 4 or 5 operation.
- Up to 256MB of standard SIMM-based Cache Memory for highest performance.
- "Hot-Swap", "Hot-Spare" and Auto Rebuild features assure maximum data availability and reliability.
- Supports Global Hot Spare(s) for maximum efficiency.

- Battery backed cache. This is an absolute must in any controller to assure RAID data integrity should power fail during write operations.
- Built-in-test and failure reporting for all major components.
- Completely hardware based - no drivers or special software required for RAID operation.
- Support up to 3 separate Ultra Wide SCSI Host Channels for multi-hosting or for maximum performance and configuration flexibility in single Host applications. Connect DEC VAX, UNIX Workstations, and Novel PC networks all to the same RAID.
- Tag Queuing support on both Host and Target SCSI ports for maximum performance and throughput. The RAID architecture is designed to optimize use of Tag Queuing Host drivers and SCSI disks.
- Optional Vision software for remote monitoring of the Voyager 5000.
- Supports "Just a Bunch of Disks (JBOD)" configuration for stand-alone device.
- SCA architecture for enhanced reliability and true "Hot Swap".

The Voyager 5000 Family

The Voyager 5000 series is designed for high capacity, high performance applications. It is user configurable as RAID 0, 1, 0+1, 4, 5 with a single controller supporting up to 42 drives. Vision software (local), 16MB cache, redundant PSU's and ACM's are supplied as standard.

One host channel is supplied with the standard building block and may be expanded to three channels as described in the Voyager 5000 Options section.

Both Rackmountable and Data Warehouse solutions are available in high availability configurations where each string of drives is connected to two RAID controllers. These controllers may be set up to run in an *Active/Active* configuration which means that each controller services its own chosen workload and is available to take over the workload of the other controller should it (the other controller) fail.

The Voyager 5000 series is divided into *Data Warehouse* solutions and *Rack-*

mountable solutions. Both solutions are again further subdivided into Single Controller and High Availability configurations. All solutions include a controller shelf and either 3, 5, or 6 disk shelves.

In the configuration tables shown for the Voyager 5000 the "XX" suffix refers to the host connection and a key is shown in Table 1-1. The "Y" suffix refers to the power supply voltage where a value of "1" is the 110V option and a value of "2" is the 220/240V option.

A maximum of three host channels are supported.

Table 1-1 Host SCSI Bus Options

FW	Fast Wide single ended
FWD	Fast wide differential
UW	Ultra SCSI wide
UD	Ultra SCSI wide differential

Voyager 5000 Data Warehouse Models

Data warehouse solutions incorporate a 22U cabinet. Six storage shelves and one controller shelf will completely fill the 22U cabinet.

Table 1-2 shows the part numbers and descriptions for the Voyager 5000 single controller Data Warehouse models.

Table 1-2 Voyager 5000 Data Warehouse single controller options

Model	Description
VRA-5003D-XX-Y	3 shelf, 21 bays, 6 drive channels, expandable to 42 bays.
VRA-5005D-XX-Y	5 shelf, 35 bays, 5 drive channels, expandable to 42 bays.
VRA-5006D-XX-Y	6 shelf, 42 bays, 6 drive channels.

The Voyager 5000 high availability models feature dual Active controllers. Storage capacity of up to 36 drives is available. Table 1-3 shows the part numbers and descriptions for the high availability models.

Table 1-3 Voyager 5000 Data Warehouse high availability options

Model	Description
VRA-5003DHA-XX-Y	3 shelf, 21 bays, 6 drive channels, expandable to 36 bays.
VRA-5005DHA-XX-Y	5 shelf, 35 bays, 5 drive channels, expandable to 36 bays.
VRA-5006DHA-XX-Y	6 shelf, 36 bays, 6 drive channels.

Voyager 5000 Rackmountable Models

The rackmountable models are similar to the Data Warehouse options except that no cabinet is included. The single controller models are shown Table 1-4.

Table 1-4 Voyager 5000 Rackmountable single controller configurations

Model	Description
VRA-5003R-XX-Y	3 shelf, 21 bays, 6 drive channels, expandable to 36 bays.
VRA-5005R-XX-Y	5 shelf, 35 bays, 5 drive channels, expandable to 42 bays.
VRA-5006R-XX-Y	6 shelf, 42 bays, 6 drive channels.

The high availability models are shown in Table 1-5.

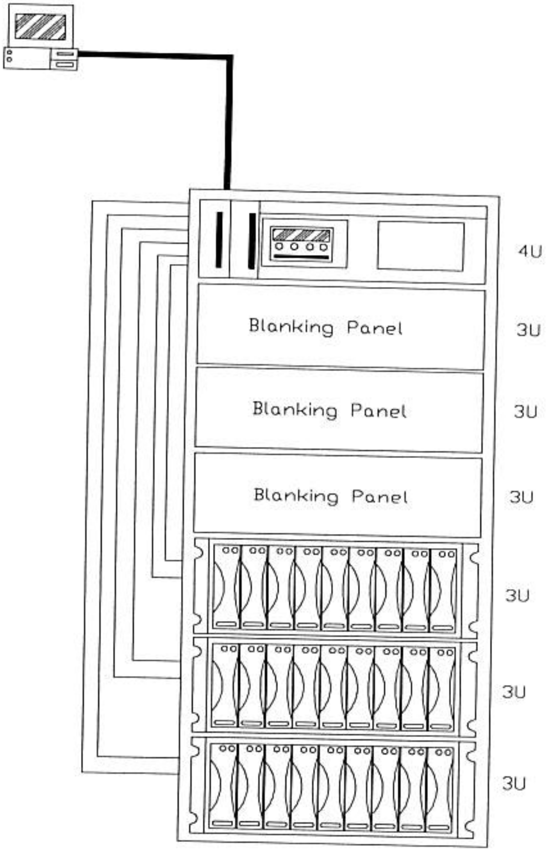
Table 1-5 Voyager 5000 Rackmountable high availability configurations

Model	Description
VRA-5003RHA-XX-Y	3 shelf, 21 bays, 6 drive channels, expandable to 36 bays.
VRA-5005RHA-XX-Y	5 shelf, 30 bays, 5 drive channels, expandable to 36 bays.
VRA-5006RHA-XX-Y	6 shelf, 36 bays, 6 drive channels.

VRA-5003D-XX-Y

Figure 1-1 shows the VRA-5003-XX-Y three shelf system. In this case each shelf is configured as two separate buses with four drives on one bus and three on the other bus. This gives a total of 21 drives. The optimum RAID configuration which maximizes performance and redundancy is to build the RAID set across separate buses. This is a representation of the data warehouse configuration, the rackmountable version is similar except that the cabinetry is not supplied.

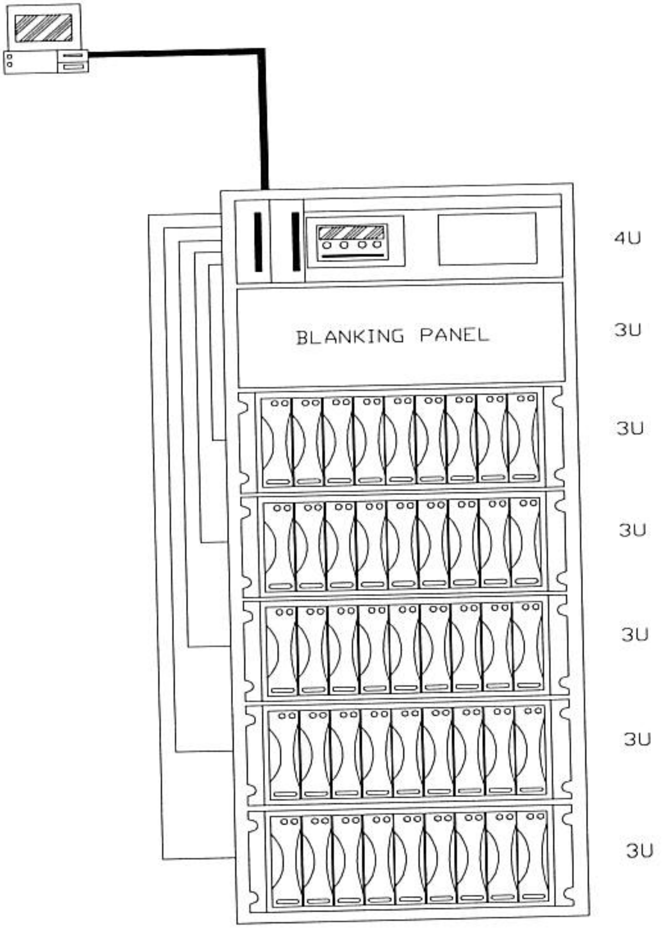
Figure 1-1. VRA-5003-XX-Y



VRA-5005D-XX-Y

Figure 1-2 shows the VRA-5005D-XX-Y. The RAID controller interfaces to the 5 target shelves via 5 SCSI cables. Each shelf is configured as a single SCSI bus. This allows a total capacity of 35 drives.

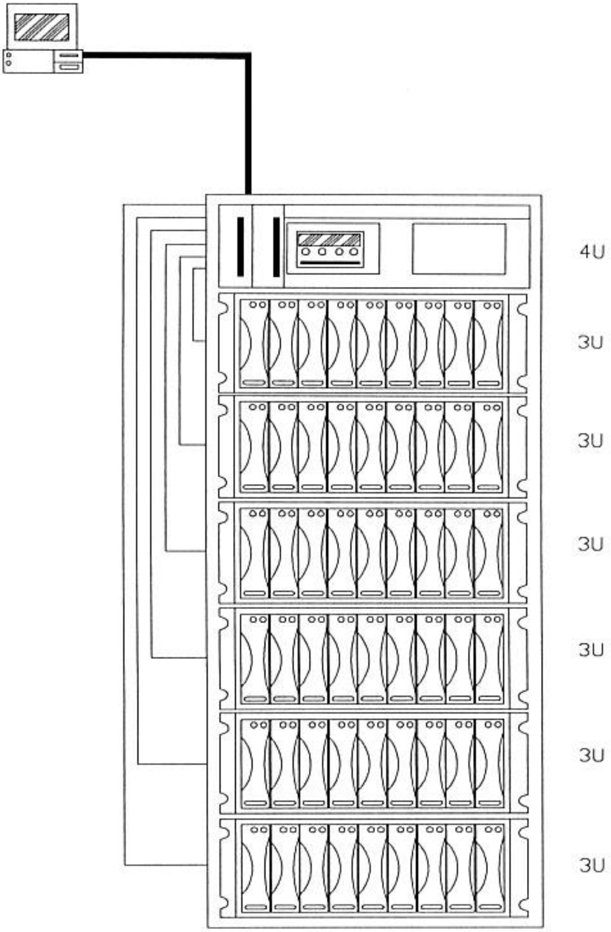
Figure 1-2. VRA-5005D-XX-Y



VRA-5006D-XX-Y

Each target shelf is configured as a single SCSI bus which connects to the controller through six SCSI channel cards giving a capacity of 42 drives. This cabinet is fully populated and is shown in Figure 1-3.

Figure 1-3. VRA-5006-XX-Y

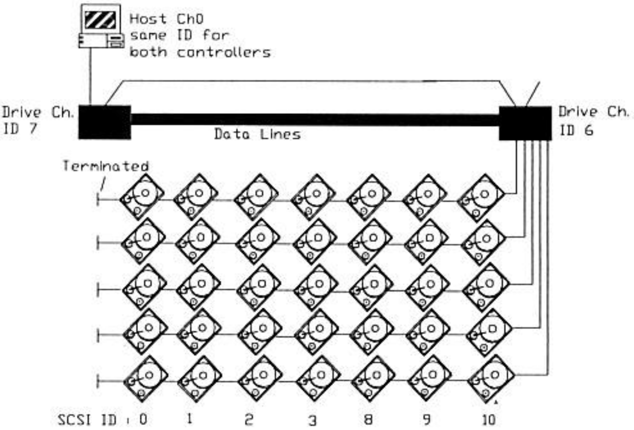


High Availability Systems Configuration Details

Detailed High Availability Single Host Example

The diagram shown in Figure 1-4 shows how a 5 channel, single host high availability system may be connected together. In practical terms due to cable length restrictions it is more likely that the SCSI cabling between disks and controllers will start at one controller, daisy chain to the other and finish at the last drive in the chain. Using two host channels in each controller gives the ability to configure a system with both controllers active.

Figure 1-4. Single Host High Availability Example

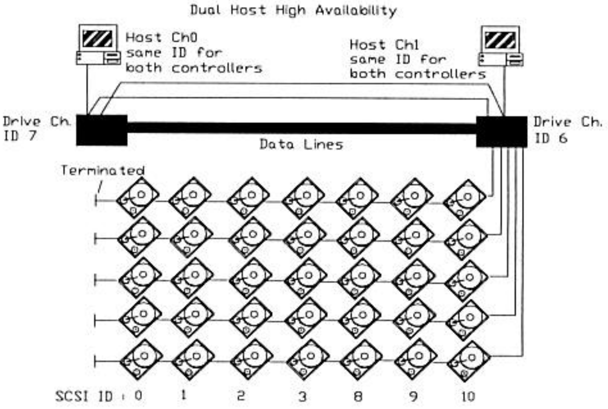


Traffic is balanced by mapping LUNs to each host channel card and by selecting the first host card in the first controller and the second host channel card in the second controller to service I/O. Should the first controller fail then the first host channel card in the second controller will handle its workload, and if the second controller fails then then the second host channel card in the first controller will handle the workload. In normal operation then the second host card in the first controller is passive as is the first host card in the second controller.

Detailed High Availability Dual Host Example

In the example shown in Figure 1-5 each controller has two host channels. The first host is connected to host channel 0 on both controllers and the second host is connected to host channel 1 on both controllers. In this example we could set all four channel cards to SCSI ID 0.

Figure 1-5. Dual Host High Availability Example

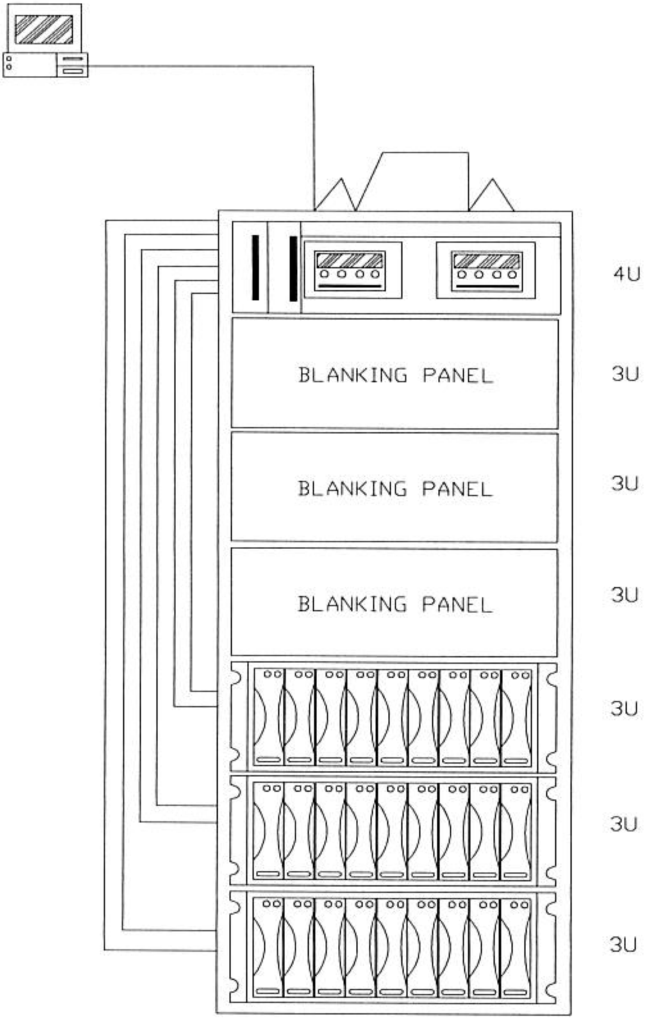


VRA-5003DHA-XX-Y

Figure 1-6 shows a high availability data warehouse solution. In this instance only six SCSI IDs are available for each storage shelf as the two controllers are connected in the same SCSI chains. We split each shelf into two buses which allows seven drives to be present in each shelf.

With this configuration, host channel 0 on both controllers is set at SCSI ID 0 and host channel 1 on both controllers is set at SCSI ID 1. A possible configuration here would be to treat host channel 0 in controller A as the active SCSI ID 0 device and host channel 0 in controller B as the passive device. We would then use host channel 1 in controller B as the active SCSI ID 1 device and treat host channel 1 in controller A as the passive device. In this way we can optimize performance by spreading the load across both RAID controllers.

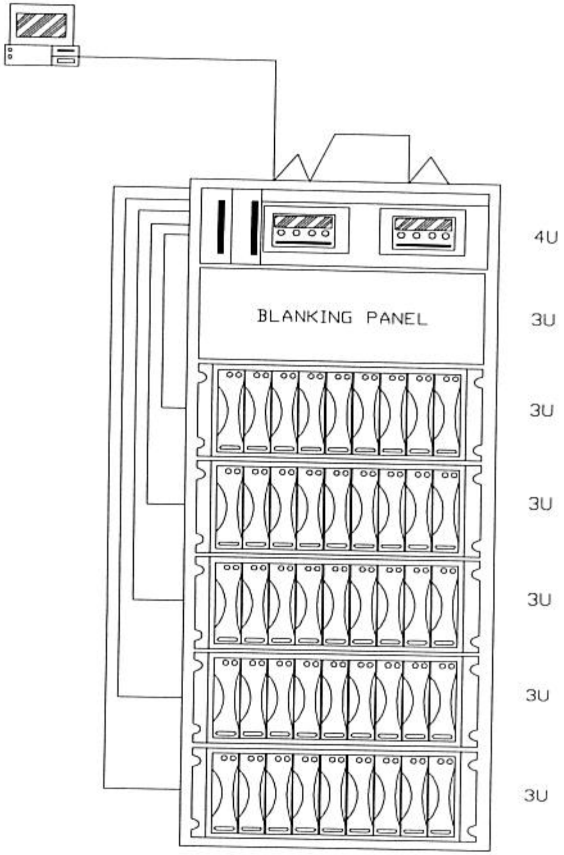
Figure 1-6. VRA-5003DHA-XX-Y



VRA-5005DHA-XX-Y

A VRA-5005DHA system is similarly configured to the VRA-5003DHA. It has five disk shelves and one controller shelf. Both controllers have two host interfaces and are connected the same way as described for the VRA-5003DHA system. A total of 30 disk drives may be connected occupying the first six storage bays (as viewed from the left) of each shelf. The seventh storage bay does not house a disk drive.

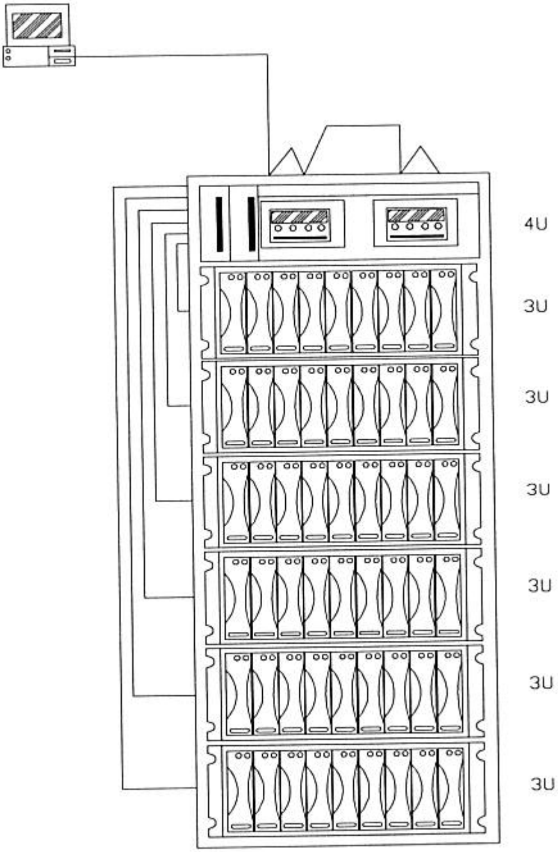
Figure 1-7. VRA-5005DHA-XX-Y



VRA-5006DHA-XX-Y

A VRA-5006DHA system is similarly configured to the VRA-5003DHA. It has six disk shelves and one controller shelf. Both controllers have two host interfaces and are connected the same way as described for the VRA-5003DHA system. A total of 36 disk drives may be connected occupying the first six storage bays (as viewed from the left) of each shelf. The seventh storage bay does not house a disk drive.

Figure 1-8. VRA-5006DHA-XX-Y



Voyager 5000 Options

This section outlines the part numbers and options available within the Voyager 5000 range.

Cache Options

MEM-72P016M-60	16 MB SIMM Module
MEM-72P032M-60	32 MB SIMM Module
MEM-72P064M-60	64 MB SIMM Module

Host Cards

There may be up to three hosts in a 6 channel configuration.

VHC-5000-FW	F/W SCSI Host Card (20MB/s), cable and terminator
VHC-5000-WD	Differential SCSI Host card (20MB/s), cable and terminator

Expansion

VRA-5001E-Y	Single expansion for VRA-5003 or VRA-5005 - 1 shelf, 7 bays, 1 F/W channel card.
VRA-5003E-Y	Three shelf expansion for VRA-5003D or VRA-5003DHA - 3 shelves
VRA-5001EHA-Y	Single expansion for VRA-5003 or VRA-5005 - 1 shelf, 7 bays, 2 F/W channel cards.

Rackmount Cabinets

VCB-2200-Y	Voyager 19" Rackmount 22U cabinet - includes dual power distribution system.
VCB-3200-Y	Voyager 19" Rackmount 32U cabinet - includes dual power distribution system.
VCB-4200-Y	Voyager 19" Rackmount 42U cabinet - includes quad power distribution system.

Vision Software

VIS-RC2-CD	Remote version of Vision remote control and monitor software for Voyager 5000 series.

Design

Within the Voyager 5000 range there are two kinds of shelf design.

The first has provision for seven 3.5" disk drives in removable disk carriers and is known as the Disk Shelf.

The second provides mounting locations for up to four 5.25" half height units or two full height units and is known as the Controller Shelf.

All types of shelf have two load sharing power supplies. Normally both supplies are in operation but in the unlikely event of a failure, each individual PSU can sustain the shelf independently.

Each drive is mounted in a carrier for ease of removal and replacement.

The Voyager 5000 Controller features a separate SCSI Channel Card with it's own CPU, memory and SCSI interface for each SCSI DRIVE string and HOST connection giving maximum performance.

One or more drives in the array can be configured as a Global Hot or Warm spare. In the event of a disk or channel failure the first spare drive found of the required capacity is automatically brought on line and the data is reconstructed automatically without the operator intervention.

Monitoring, configuring and testing of the system can be carried out via Eurologic's Vision software, the front panel display or through an attached terminal.

The controller is battery backed up to protect any data in its cache from sudden power interruptions. This means that if system power is shut down during a write operation, the battery supplies auxiliary power to the cache, however, because the amount of time that the battery can maintain power for is finite, Eurologic recommend that a more stable means of coping with power outages is employed such as the use of an Uninterruptedly Power Supply (UPS).

The Need for RAID

Fixed disk manufacturers have made great strides in designing faster and more capacious devices. Yet advancements in processor technology have far outpaced their efforts. As a result, fixed disks still act as brakes on todays turbocharged computer systems. Modern processors sometimes operate at less than full capacity or even sit idle while waiting for the fixed disk to write or read data.

Improvements in fixed disk technology could be tolerated if disk accessing occurred infrequently. But the trend is heading towards more disk accessing, not less. Networks and applications such as imaging and graphics are placing heavy, new burdens on fixed disk drives, emphasizing the need to bridge the gap between processor performance and input/output rates.

Data availability is another trend that is driving innovation in fixed disk technology. In many instances today, computers are the only repositories for critical business or scientific data. When a hard disk crashes, restoring the data from tape may take hours, and even then data saved since the last backup will be lost. Disk mirroring provides a high degree of data availability - but at double the cost of a non-mirrored system.

What is RAID?

In simple terms, when ever the Voyager 5000 controller receives instructions from the host to write a block of data to the array, it "stripes" or breaks that block of data into smaller pieces and apportions the pieces among the drives in the array. In this way, each drives's actuator gets into the act, decreasing the time needed to complete the write operation. Similarly, when the host asks to read a block of data from the array, the Voyager 5000 determines which drives are involved and simultaneously fetches the data from each drive, again making use of the multiple actuators at its disposal.

RAID (redundant array of independent disks) offers significant advantages on both fronts. It offers increased speed, because, in effect, it turns several independent drives into one big drive with multiple actuators. The controller can manipulate these actuators either in parallel to share the work on reads or writes of large files or independently to perform multiple, simultaneous reads or writes of small files. RAID improves data availability by performing parity calculations on every bit of data written to the array. This parity information is saved on the array and can be used to reconstruct the data on any drive that goes bad. In addition to mirroring, where the ratio between data drives and redundant drives is one to one, the Voyager 5000 RAID controller can support a ratio of up to six data drives for each parity drive.

Custom Components

To increase performance and reliability, the Voyager 5000's core functions have been encapsulated in four custom ASIC (Application Specific Integrated Circuits) components.

XOR ASIC

Used in the Exclusive-Or parity calculations employed by RAID levels four and five.

DMA ASIC

Controls the data path hardware for the various I/O ports.

CPU Interface ASIC

Supports the controllers MIPS R3000 RISC central processing unit.

Memory Controller ASIC

Controls the memory system and supports data movement on the internal bus at a maximum burst rate of 80 MB/s and a maximum sustainable rate of 60 MB/s.

Efficient Write and Read Algorithms

Standard RAID write operations that involve parity, such as those in RAID levels 4 and 5, require multiple, time consuming steps:

1. Read data from the parity drive.
2. Read existing data from the target data drives.
3. Exclusive-Or the old parity, old data and new data to generate new parity data.
4. Write the new parity data to the parity drive.
5. Write the new data to the target data drives.

The Voyager 5000 uses several techniques to streamline write operations and significantly improve performance. All the techniques use the controller's onboard cache, which can contain up to 512 megabytes of memory in the form of standard 72-pin, 60 nanosecond SIMM modules.

NOTE: The Voyager 5000 will not operate without at least one 4MB SIMM installed in its cache. However, there will be a performance impact with only 4 MB and Eurologic recommends the minimum use of 16MB. The cache is battery backed for limited protection, however, more stable means should be employed to protect against long term power failures. Without a backup, data stored in the cache but not yet written to the disk drives would be lost in the event of a power interruption.

Write-Back Caching

When the host sends data to be written to a redundancy group, the controller stores the data in its cache and immediately reports to the host that it has completed the write. The controller eventually writes the data to the disk drives, when the write can be done most efficiently or when the controller must flush the cache to make room for other data or to prepare for a shutdown.

Write-Back Caching makes the host more responsive to the user, since the host does not have to wait for a lengthy RAID write before processing another task.

Write Gathering

The Voyager 5000 will attempt to consolidate multiple writes destined for contiguous blocks and then write the entire data block in one operation. The controller stores the data in cache until it performs the write. Ideally, the controller will wait until it has gathered enough data to fill an entire stripe. This enables the controller to avoid reading from the parity and data drives before making the write. All it has to do is calculate parity from the data it already has in its cache, then write the data and parity to the drives. Even if the controller cannot accumulate enough data to fill a stripe, the consolidation of multiple small writes can reduce the number of read/write operations that must take place.

Write On Top

If the host commands that the data be written to disk, and data for that address is pending in the controllers cache, the controller writes the new data on top of the old in the cache. Only the new data is eventually written to the disk drives.

RAID Levels Supported

The Voyager 5000 supports JBOD configurations as well as the following RAID levels:

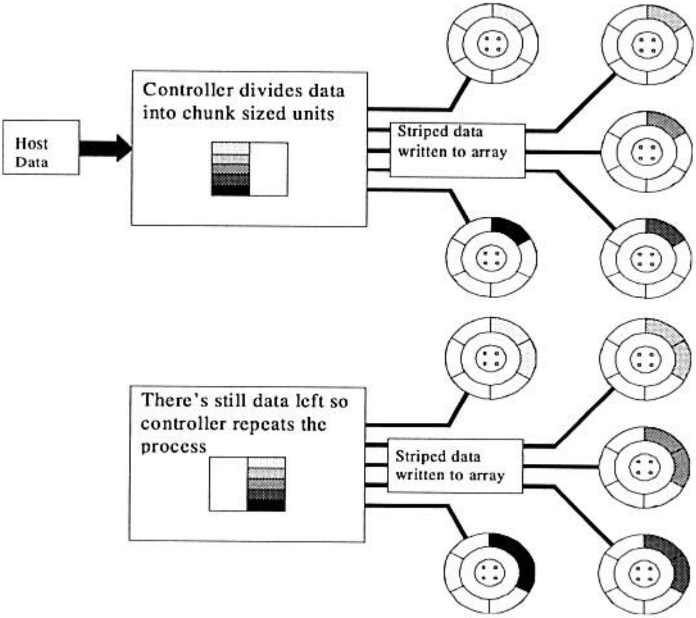
Table 1-6 Supported RAID Levels

RAID Level	Description
0	Striping without parity
1	Mirroring
0+1	Striping and mirroring
4	Striping with fixed parity drive
5	Striping with floating parity drive

RAID 0

RAID 0 breaks up data into smaller chunks and then writes each chunk to a different drive in the array. The size of each chunk is determined by the controllers chunk size parameter, which you set in the course of creating a RAID set.

Figure 1-9. RAID 0 Write


Host
Data
Controller divides data into chunk sized units
Striped data written to array
There's still data left so controller repeats the process
Striped data written to array

The advantage of RAID 0 is its high bandwidth. By breaking up a large block of data into smaller chunks, the controller can use multiple drive channels to write the chunks to the disk drives. Furthermore, RAID 0 involves no parity calculations to complicate the write operation. Likewise, a RAID 0 read operation employs multiple drives to assemble a single, large data block. This makes RAID 0 ideal for applications, such as graphics, video, and imaging, that involve the writing and reading of huge, sequential data blocks.

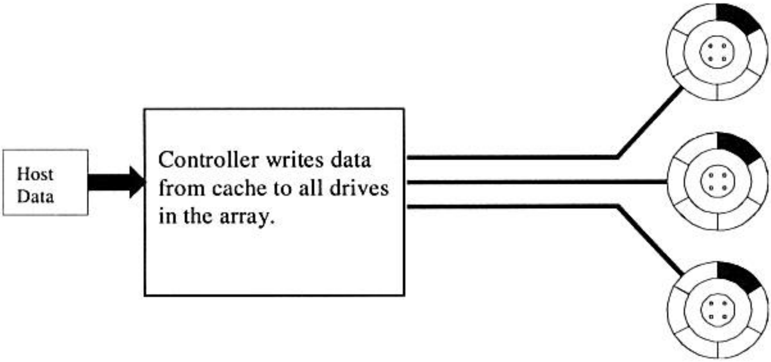
WARNING: The lack of parity means that a RAID 0 disk array offers no redundancy and thus cannot recover from a drive failure.

RAID 1

RAID 1 (also known as mirroring or shadowing) takes data sent by the host and duplicates it on all the drives in the array. This results in a high degree of data availability, since you can loose all but one drive in the array and still have full access to your data. This comes at a price: a RAID 1 array requires multiple drives to achieve the storage capacity of a single drive.

A RAID 1 array will show up on the monitor as "Degraded" when at least one drive fails, even if two or more members of the redundancy group remain in good working order. As long as at least two working drives remain in the array, you may continue to run the array in degraded mode without putting your data in jeopardy.

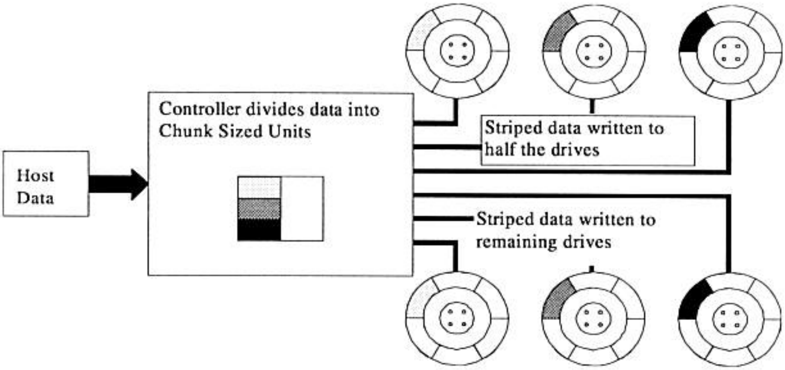
Figure 1-10. RAID 1 Write


Host
Data
Controller writes data from cache to all drives in the array.

RAID 0+1

As its name implies, RAID 0+1 combines RAID 0 (striping) with RAID 1 (mirroring). In a RAID 0+1 write, the controller breaks up the data block from the host into smaller chunks, then writes the chunks to half the drives in the array, while writing duplicate chunks to the remaining drives.

Figure 1-11. RAID 0+1 Write



In the event of a drive failure, a RAID 0+1 array will enter degraded mode and continue to operate by substituting the failed drive with its mirror.

When the controller creates a RAID 0+1 set, it first sorts the drives by channel number and SCSI ID. Then it stripes the data across every other drive and forms a mirrored pair with the first two drives, another mirrored pair with the second two drives, and so on. Table 1-7 describes how the controller uses the drives in a RAID 0+1 set.

Table 1-7 RAID 0+1 Example

Drives Selected	Function
Channel 1, ID 0	First member of stripe set.
Channel 1, ID 1	Mirror of Channel 1, ID 0.
Channel 1, ID 2	Second member of stripe set.
Channel 2, ID 0	Mirror of Channel 1, ID 2.
Channel 2, ID 1	Third member of stripe set.
Channel 2, ID 3	Mirror of Channel 2, ID 1.

RAID 4

RAID 4 breaks up host data into chunks, calculates parity by performing an exclusive-OR on the chunks, and then writes the chunks to all but one drive in the array with the parity information written to the last drive. When the host requests data from the disk drives, the controller retrieves the chunks containing the addressed data, reconstitutes the data from the chunks, and passes the data to the host.

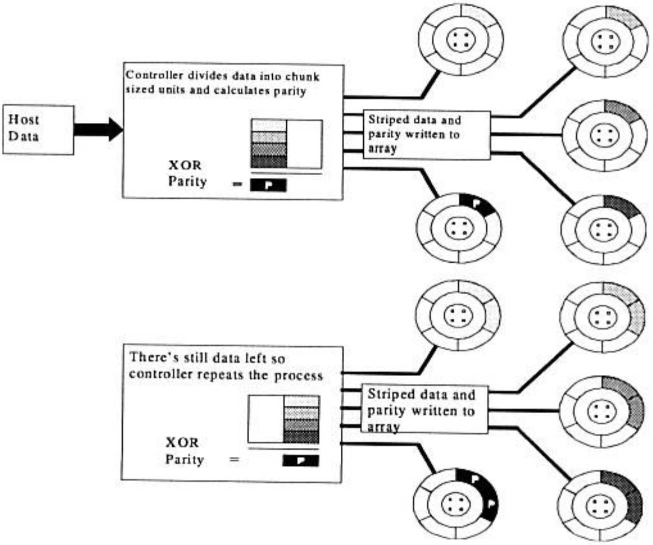
In the event of a single drive failure a RAID 4 array will continue to operate in degraded mode. If the failed drive is a data drive, writes will continue as normal, except no data will be written to the failed drive. Reads will reconstruct the data on the failed drive by performing an exclusive-OR operation on the remaining data in the stripe and the parity of that stripe. If the failed drive is a parity drive, writes will occur as normal, except no parity will be written. Reads will simply retrieve data from the data disks. There will be no deterioration in controller performance while a RAID set is in degraded mode.

In general RAID 4 is best suited to applications such as graphics, imaging, or video that call for reading and writing huge sequential blocks of data. However, you may find that RAID 4 is preferable to RAID 5 even for applications characterized by many small I/O operations, such as transaction processing. This is due to the Voyager 5000's intelligent caching, which efficiently handles small I/O reads and writes, and to the relatively less complex algorithms needed to implement RAID 4.

The benefits of RAID 4 disappear when you have many, small I/O operations scattered randomly and widely across the disks in the array. RAID 4's fixed parity disk becomes a bottleneck in such applications, as the following example illustrates. Let's say the host instructs the controller to make two small writes. The writes are widely scattered, involving two different stripes and different disk drives. Ideally, you would like both writes to take place at the same time, but RAID 4 makes this impossible, since the writes must take turns accessing the fixed parity drive. For this reason, RAID 5 is the better choice for widely scattered, small write operations.

WARNING: RAID 4 can withstand a single drive failure and handle I/O activity without interruption in degraded mode until the failed drive is rebuilt. If a second drive fails while the RAID set is in degraded mode, the entire RAID set will fail.

Figure 1-12. RAID 4 Write


Controller divides data into chunk sized units and calculates parity
Host Data
Striped data and parity written to array
XOR Parity =
P
There's still data left so controller repeats the process
Striped data and parity written to array
XOR Parity =
P

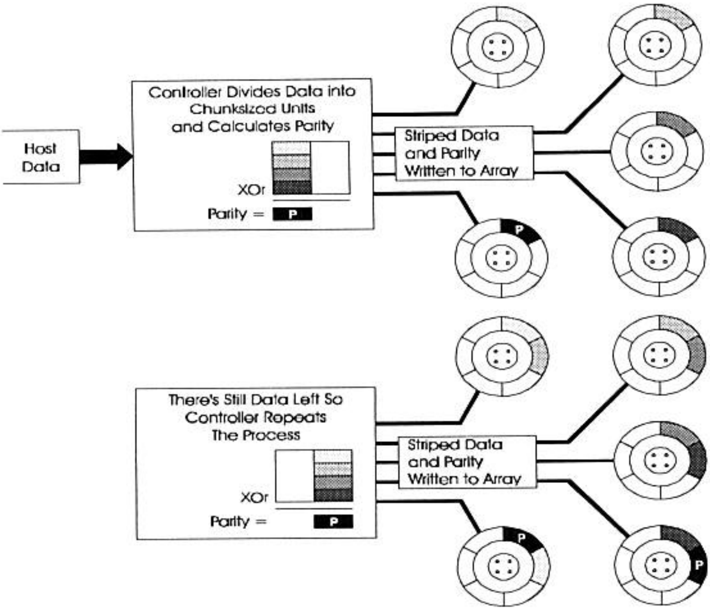
RAID 5

RAID 5 addresses the bottleneck issue for barrages of widely scattered, small I/O operations. Like RAID 4, RAID 5 breaks data up into chunks, calculates parity, and then writes the chunks in stripes to the disk drives, saving one drive on each stripe for the parity data. Unlike RAID 4, however, RAID 5 changes the parity drive on each stripe. This means, for instance, that a write operation involving drive 2 on stripe 1 can conceivably take place at the same time as a write involving drive 3 on stripe 2, since they would be addressing different parity drives.

RAID 5 handles drive failures in the same manner as RAID 4, except the parity drive is different for each stripe. The controller either uses the parity information on a stripe to reconstruct its data or simply reads the data as normal, depending on the location of the stripe's parity drive.

While RAID 5 is ideally suited for applications with many, small I/O operations, there is no reason why it cannot function equally well for applications with large, sequential I/O operations. This makes RAID 5 an excellent all-purpose RAID level.

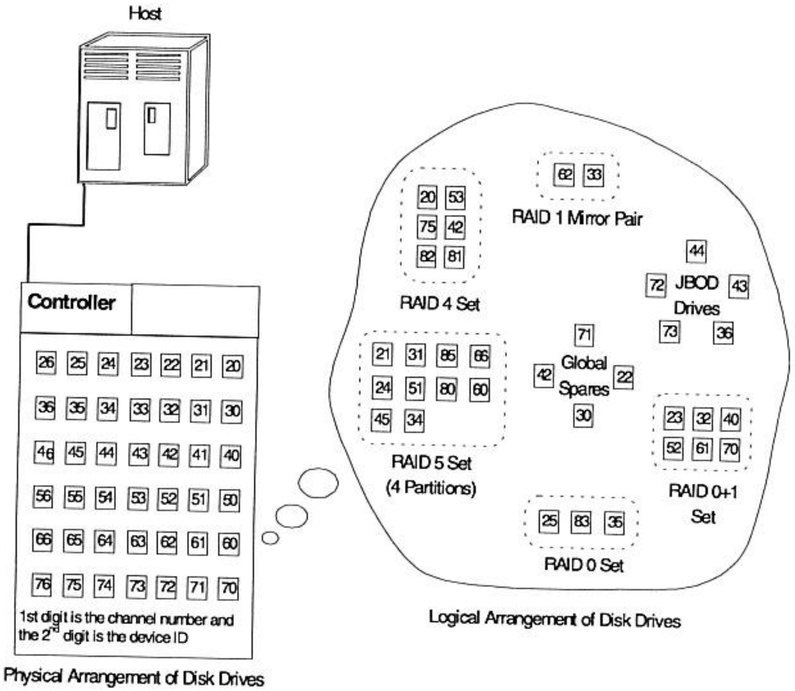
Figure 1-13. RAID 5 Writes


Host Data
Controller Divides Data into Chunksized Units and Calculates Parity
XOr
Parity = P
Striped Data and Parity Written to Array
P
There's Still Data Left So Controller Repeats The Process
XOr
Parity = P
Striped Data and Parity Written to Array
P
P

WARNING: RAID 5 can withstand a single drive failure and handle I/O activity without interruption in degraded mode until the failed drive is rebuilt. If a second drive fails while the RAID set is in degraded mode, the entire RAID set will fail.

A RAID set is an entity that has meaning to the controller only. Figure 1-14 shows an example of how the controller's drives may be combined to suit different needs. It is the partitions within a RAID set that have meaning to the Host as they will be presented as logical drives. Whilst the diagram below shows logical arrangements of drives consideration should be given to the actual hardware layout (i.e. spreading a RAID set across different SCSI channels).

Figure 1-14. Host's view of RAID sets



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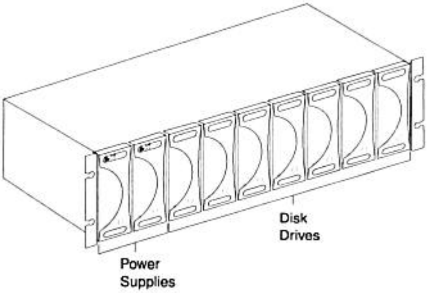
Chapter 2: Voyager 5000 Basic Components

CAUTION: Only fully trained personnel should access the rear of the cabinets.

Shelf Type

There are two types of shelf used through the Voyager 5000 family, the disk shelf, and the controller shelf

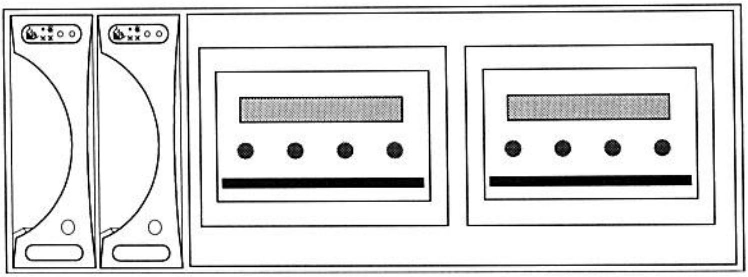
Figure 2-1. The Disk Shelf



Each disk shelf assembly contains two load sharing power supply units and up to seven peripheral bays. They are discussed in detail later in this chapter.

The controller shelf is different to the disk shelf in basic design and the peripheral bays are replaced by a RAID controller and an optional peripheral. Like the disk shelf, the controller shelf contains two load sharing PSUs. It also houses a fan assembly and an I/O plate.

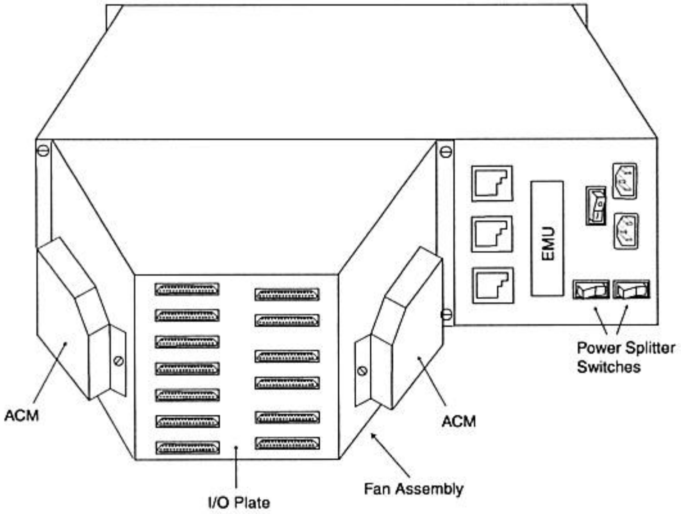
Figure 2-2. The Controller Shelf (Front View)



Controller Shelf Components

The Voyager 5000 controller self contains two load sharing power supplies and two Advanved Cooling Modules (ACMs). The controller shelf can hold one or two RAID controllers. The rear of the unit is shown in Figure 2-3.

Figure 2-3. Rear View of Controller Shelf

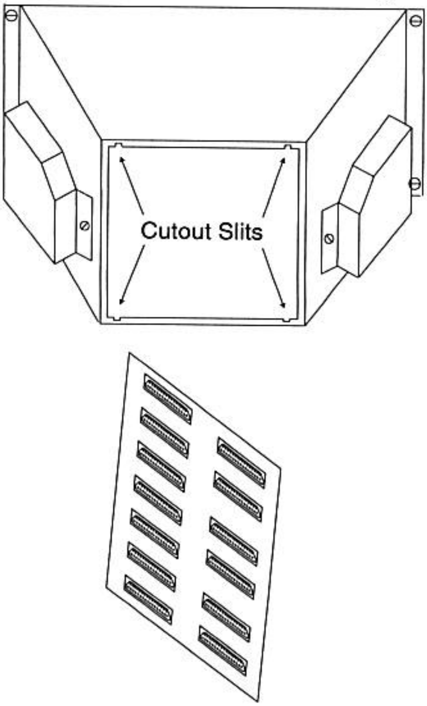


Accessing the Controller

To gain access to the RAID controllers inside the controller shelf the following procedure should be followed:

1. Remove the four Phillips head screws from the I/O plate.
2. Pull the connector plate forward and turn it so that it is at 90° to the fan assembly.

Figure 2-4. Seperating I/O Plate from Fan Assembly

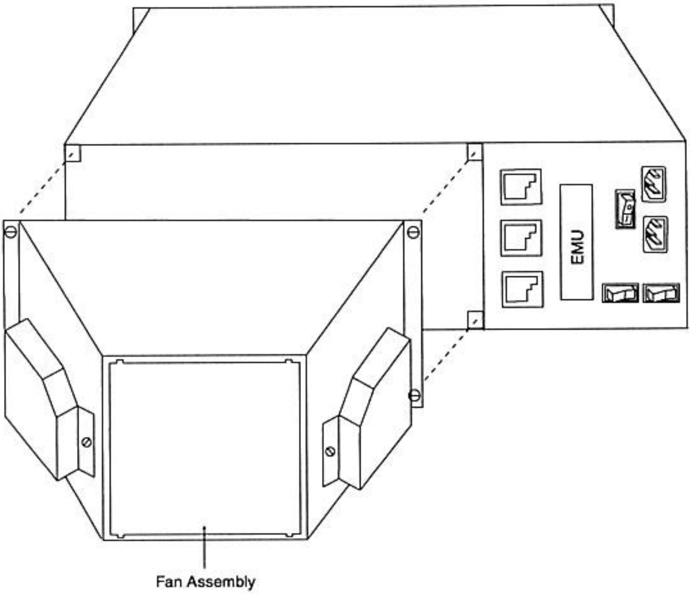


3. The I/O plate can be seperated by sliding it in through the cut-out slits on the fan assembly as shown in Figure 2-4.

The fan assembly can be removed to reveal the RAID controllers by following this procedure:

1. Loosen the four captive thumbscrews at the rear of the fan assembly.
2. Gently seperate the fan assembly from the shelf (see Figure 2-5).

Figure 2-5. Accessing the RAID Controllers inside controller shelf

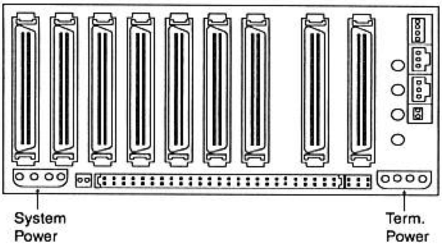


3. Remove the fan assembly from the shelf.

Connecting DC Power to Controllers

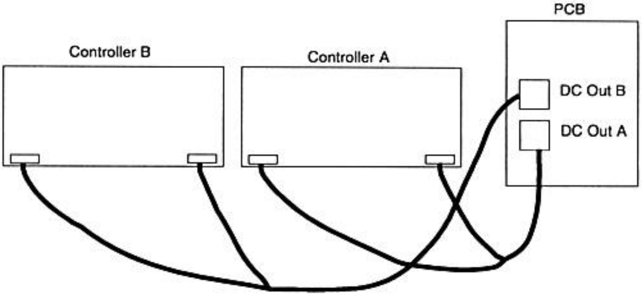
Once the fan assembly has been removed from the controller shelf, the rear of the controller(s) (see Figure 2-6) can be seen.

Figure 2-6. Rear View of Controller



The System Power and Term. Power connectors are shown. DC power must be supplied to both of these connectors. The DC power is supplied to both these locations through the PCB located to the right hand side of the controller shelf (when viewed from the rear). Figure 2-7 below shows how to connect the DC power to the controller and which DC Out connector corresponds to which controller.

Figure 2-7. Connecting DC Power to the Controllers (viewed from rear)



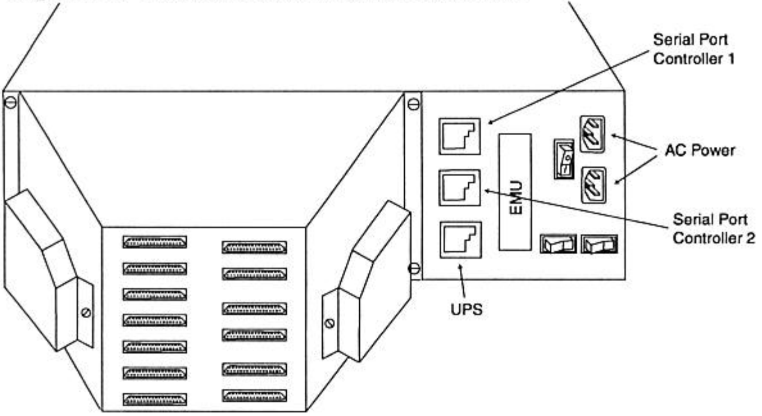
The power to each controller can be turned on or off by using the Power Splitter switches located on the rear of the controller shelf (see Figure 2-3). The power splitter switch on the right (when viewed from the rear) corresponds to Controller A, while the power splitter switch on the left (when viewed from the rear) corresponds to Controller B.

CAUTION: The power splitter switches control the controller battery also. If the unit is powered down and the switches are left switched on, the battery will run down.

External Connectors

The external connectors on the rear of the controller shelf are shown in Figure 2-8.

Figure 2-8. Controller Shelf External Connectors



Serial Port Connectors

The serial connectors on the rear of the controller shelf I/O plate allow connection between the Voyager 5000 and an external monitor. There is a seperate serial connector for each controller in the controller shelf. The top serial connector corresponds to Controller A and the middle serial connector corresponds to Controller B. Chapter 5 describes the procedure for connecting an external monitor to the Voyager 5000.

NOTE: If an EMU is installed in the controller shelf, the top serial port (controller A) will be in -active. The serial port on the EMU should be used instead (see Chapter 4).

UPS Connector

The bottom connector shown in Figure 2-8 above facilitates the connection of an Uninteruptable Power Supply (UPS) to the controller shelf. For more details on connecting the UPS refer to Chapter 8.

EMU Connector

An Environmental Monitoring Unit (EMU) can be inserted into the controller shelf at the location marked EMU in Figure 2-8 above. For more information on the EMU refer to Chapter 3.

AC Power

AC power to the controller shelf is supplied through the two power receptacles shown in Figure 2-8. Each power receptacle supplies power to a separate power supply. The power is switched on using the power switch located beside the power receptacles.

⚠ **CAUTION: To ensure redundancy of the power supplies, both power cords must be connected to the controller shelf.**

Removing a RAID Controller from the Controller Shelf

To remove a RAID controller from the controller shelf the following procedure must be followed:

1. Shut down the controller using the shut down menu option in the controller's monitor utility (see Chapter 5).
2. Turn off the power to the controller shelf by switching off the power switch located betweent the two power receptacles on the rear of the shelf.
3. Remove the power cords.
4. Remove the I/O plate and fan assembly as described earlier in this chapter.
5. Remove all the cables from the controller to be removed.
6. Remove the two Phillips head screws from the front of the Controller Shelf and remove the front plate.
7. The controller can now be removed from the Controller Shelf.

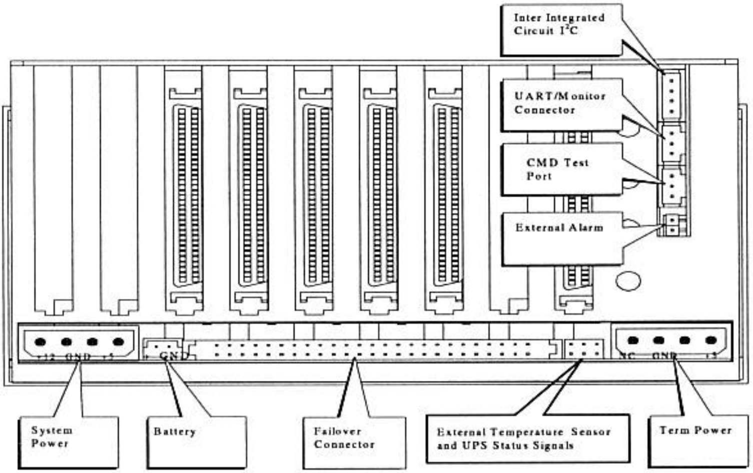
Voyager 5000 Controller

The next section discusses the Voyager 5000 controller along with its associated components.

Controller Connectors

The Voyager 5000 controller has a number of connectors on the back panel, including three power connectors. One of the connectors is intended for the battery backup. The other two connectors split the current entering the controller: one connector supplies the relatively small amount of current required for the controller's system, and the other supplies the potentially much larger amount of current needed to power the terminator resistors on the controller's I/O modules and the drives at the end of each SCSI bus. These connectors are shown in Figure 2-9.

Figure 2-9. Backplane Connectors



System Power

Provides 12±10% volts DC (3 amps maximum) and 5±5% volts DC (4 amps maximum) to power the controller's systems.

Term Power

Provides 5±5% volts DC to terminator resistors on the host and drive channels. The first pin in the socket, which may be connected to 12 volts, is not used. The amount of current on this line will depend on the number of drive channels connected to the controller, whether the drive channels are 8-bit or 16-bit, and even the data patterns sent to the drives. Each drive channel will require sufficient current to power two sets of terminators. A 16-bit channel will have twice as many data lines to terminate as an 8-bit channel. And a data pattern containing a preponderance of ones will require more termination power current than a data pattern with a greater proportion of zero bits. As a rule of thumb, you should expect to provide term power current of approximately 1.25 amps per I/O channel.

Battery

The Voyager 5000 controller is designed to connect a 6.0 volt DC, lead-acid backup battery with a capacity in the range of 1 to 34 amp hours. The Voyager 5000 will trickle-charge the battery during normal operation. The recharge rate is set by jumper W3, which is located between the failover connector and the I/O channel sockets (see Figure 2-10). Insert the jumper shunt for a 100 milliampere peak charge current. Remove the jumper shunt for a 10 milliampere peak charge current. The battery supplied as standard equipment is a 1.2 Ampere Hour battery and it has the capability of holding the memory circuitry at the required voltage levels for approximately 4 hours[1].

WARNING: The Voyager 5000 will not operate correctly unless it is connected to a battery backup or uninterruptible power supply (UPS). Eurologic recommends that you make sure that your battery is fully charged before connecing it to the controller. Since the Voyager 5000 trickle charges the battery, it can take several hours to fully charge a depleted battery. If power is interrupted to the controller, your data is exposed and vulnerable without an adequate battery backup. It is imperative that an UPS is used in conjunction with this battery.

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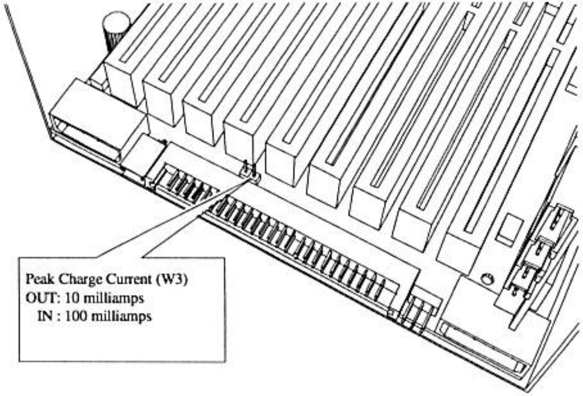
[1] This is a mean figure, and is dependent on the battery state of charge, environmental conditions and its age.

Figure 2-10. Peak Charge Current Jumper



Uninterruptible Power Supply (UPS)

The Voyager 5000 controller can also be connected to an UPS which provides early warning of imminent power loss. The controller supports two UPS signals, "AC Lost" and "Two-Minute Warning" which, like the low voltage battery conditions, force the controller to disable write back caching or reject I/O respectively.

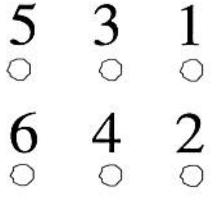
Failover Connector

This connector is used to cable two Voyager 5000 controllers together for failover operation.

External Temperature Sensor and UPS Signal Connector

This connector performs 2 functions. The odd pins may be used to attach an external temperature sensor to supplement the Voyager 5000's internal temperature sensor. (The sensor must be a National Semiconductor temperature sensor, part number LM34DZ) The even pins make it possible to bring critical status signals from an UPS unit into the controller. The following diagram and table show the pinout of the connector.

Figure 2-11. Pinout of Temperature and UPS Sensor at Controller



Refer to the UPS and battery chapter for information on the external UPS Pins.

Table 2-1 UPS and Temperature Sensor Pin-out

Pin	Description
1	Power for temperature sensor
2	UPS: low battery warning
3	External temperature sensor
4	UPS: loss of AC power
5	Ground for temperature sensor
6	Ground for UPS

Warning Alarm

A two-level temperature sensor monitors any heat build-up inside the controller. When the temperature reaches approximately 41^0 Centigrade / 105^0 Fahrenheit, the alarm will sound every two seconds. In such an event, you should take immediate steps to cool the unit or shut the system down in an orderly fashion. If the temperature climbs to approximately 49^0 Centigrade / 120^0 Fahrenheit, the alarm will sound twice a second. The controller will complete any pending I/O activity and then accept no more instructions from the host.

The alarm also sounds when the system voltage drops below 4.80 volts or climbs above 5.25 volts, or the termination power voltage drops to 4.75 volts or climbs to 5.30 volts.

You may silence the alarm by pressing Ctrl-X on the monitor keyboard or by simultaneously pressing the up and down arrow buttons on the front panel.

Disk Drives

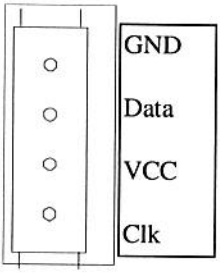
The Voyager 5000 is designed to accept SCA disk drives from virtually any manufacturer. You may mix drives of different makes and models in the same RAID set. You may even combine disk drives of different sizes in the same RAID set. If you do this, however, they will use only a portion of the larger drives. For example, if you combine a 1 gigabyte drive with two 1.2 gigabyte drives, the Voyager 5000 will treat the RAID set as if it comprised three 1 gigabyte drives. SCA drives are standard with the Voyager 5000 but non SCA drives may be connected using Eurologic's SCSI to SCA adapters.

NOTE: The Voyager 5000's only requirement for SCSI disk drives is that they must support "read long" and "write long". Most SCSI disk drives meet this criterion, but you should check the specifications of any older drives.

Inter-Integrated Circuit (I^2C) Connector

This is used for the environmental control system (ECS), which will be implemented in a future firmware release. The pinout of the connector is shown in the following diagram.

Figure 2-12. I^2C Connector



UART Connector

This is used to connect an external monitor to the controller. The Voyager 5000's monitor utility offers a means to configure the controller, create and manage RAID sets, initiate rebuild operations, and view error logs, among other functions. This interface is brought externally to the Controller Shelf Backplane and clearly marked "Serial Port" - use connector A or B as required.

Table 2-2 Serial Connector Cable Pinout

Signal	RJ1	Cable	Length	25 Way Pin
(Unused)	1	26 AWG Blue	15,000mm	----------------
Transmit Data	2	26 AWG Black	15,000mm	2
Signal Ground	3	26 AWG Orange	15,000mm	7
(Unused)	4	26 AWG Red	15,000mm	----------------
Receive Data	5	26 AWG Green	15,000mm	3
(Unused)	6	26 AWG White	15,000mm	----------------

NOTE: RJ11 connector has a Right key.

Test Port

This is intended for use by service personnel and has no application during normal operation of the controller.

External Alarm

You may connect an auxiliary alarm to the controller to supplement the internal alarm.

Cache

The Voyager 5000's cache accepts as many as four standard SIMMs.

NOTE: The Voyager 5000 will not operate without at least one SIMM installed in the cache.

How To Order SIMMs

When you purchase SIMMs, they should meet the following specifications.

Speed	60 nanoseconds
Bus Width	36 bits wide
Pins	72
Capacity	4 to 128 megabyte
IC Count	Not more than 36

NOTE: The Voyager 5000 does not support SIMMs with more than 36 integrated DRAM circuits (ICs) on board. The Voyager 5000 does not support EDO RAM.

The capacity of 36-bit-wide SIMMs may not be apparent from the listings in merchandise catalogues. Use the following table as a guide.

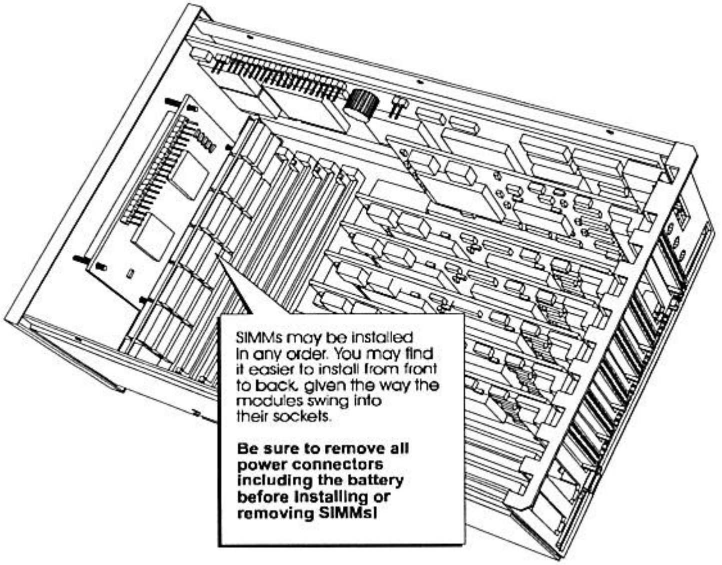
Configuration	Size	Configuration	Size
1 x 36	4 megabytes	8 x 36	32 megabytes
2 x 36	8 megebytes	16 x 36	64 megabytes
4 x 36	16 megabytes	32 x 36	128 megabytes

Installing SIMMs

The Voyager 5000 does not require that SIMMs be installed in any particular order. For purely practical reasons, you should install SIMMs starting with the socket nearest the front of the box and work your way back. This is due to the way the SIMMs swing into their sockets. You do not have to populate all the sockets, and you may skip a socket if you wish. Figure 2-13 shows how to install SIMMs in the Voyager 5000.

WARNING: Be sure to remove all power (including battery power) to the controller before installing SIMMs. When handling SIMMs ensure that adequate anti-static precautions are taken.

Figure 2-13. Installing SIMMs



SIMMs may be installed in any order. You may find it easier to install from front to back, given the way the modules swing into their sockets.

Be sure to remove all power connectors including the battery before installing or removing SIMMs!

Installing Modules

The SCSI modules of the Voyager 5000 includes 16-bit host module and 16-bit disk modules. The module type and quantity depends on the actual Voyager 5000 model used. Any module installed in slot 0 (next to the System Board) will be recognized by the controller as a host module. Modules installed in slots 1[2], 2 and 3 may be configured as either disk or host modules. Modules occupying slots 4 through 8 will be recognized as disk modules. Figure 2-14 shows a controller with 1 host module and 5 disk modules.

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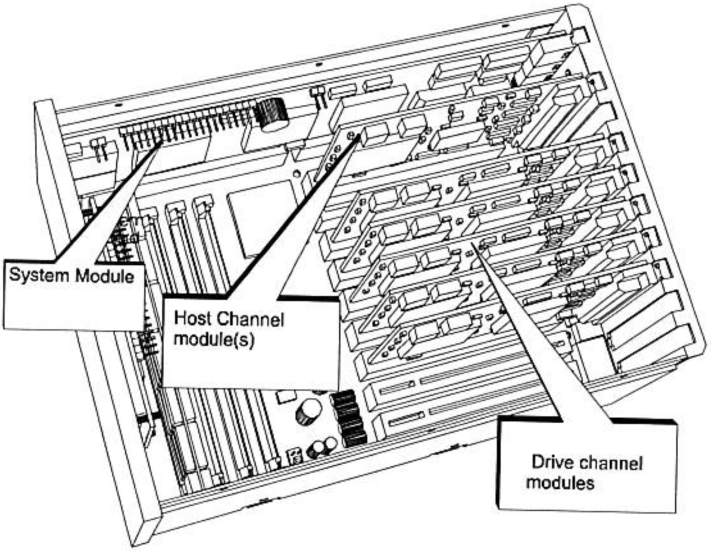
[2] Slot 1 is normally reserved for use as a second host module.

Figure 2-14. Location of Modules



Refer to the *monitor utility* chapter for further information on assigning the module type.

How to Tell Modules Apart

The Voyager 5000 I/O modules may be used for host or drive channels. The 16-bit single ended, and 16 bit differential modules share the same form factor and connector. To tell them apart you must either inspect the components on the modules or read the part number imprinted on the back of the module. The following table gives the part numbers for the Voyager 5000's I/O modules.

Table 2-3 SCSI Module Part Numbers

Part Number	Module
ELRC+5530	8-bit, single-ended I/O card[1]
ELRC+5540	16-bit, single-ended fast/wide SCSI-2 card
ELRC+5542	16-bit, single-ended Ultra/wide SCSI card
ELRC+5560	16-bit, differential fast/wide SCSI-2 card
ELRC+5562	16-bit, differential Ultra/wide SCSI card

1. Note that the Voyager 5000 does not use 8 bit modules.

The differences between the 16-bit/single-ended, and 16-bit/differential modules are subtle. Figure 2-15 and Figure 2-16 show diagrams of the modules. The key components that highlight their differences are shaded.

Figure 2-15. ELRC+5540 16 Bit Single Ended I/O Module

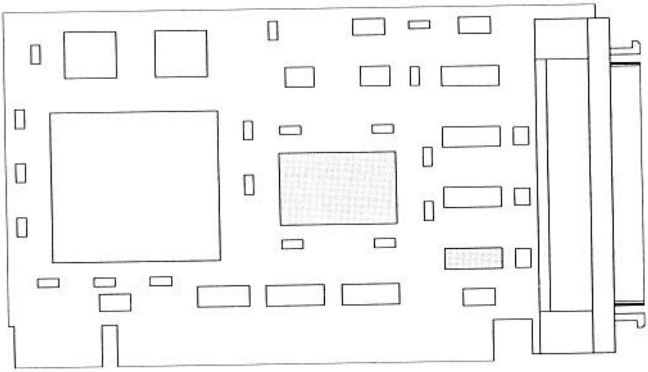
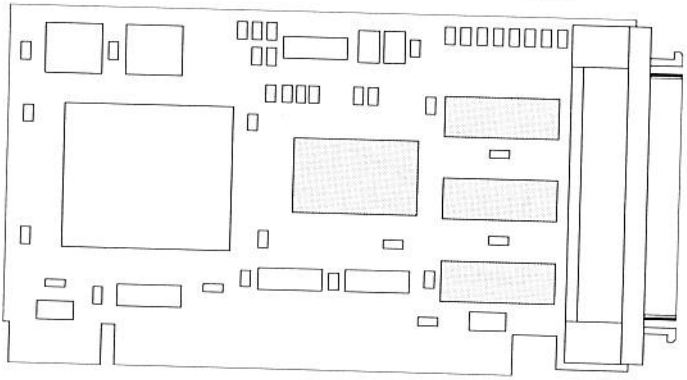


Figure 2-16. ELRC+5560 16 Bit Differential I/O Module



Controller Fan

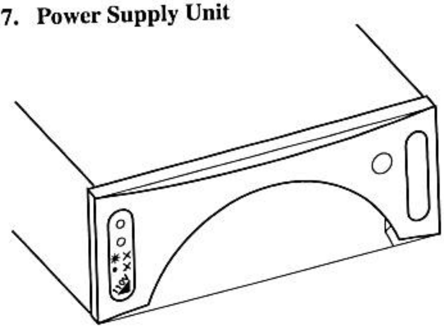
The fan built into the Voyager 5000's controller shelf gets its power from a connector on the motherboard. Should this connection be broken, which can happen easily when you remove the cover to service the inside of the box, reconnect the fan cable to the connector. The connector is polarized to ensure correct installation.

The Power Supply

Each shelf is supplied with two identical power supplies. Both power supplies possess a load sharing ability allowing them to share the load evenly in the unlikely event of a power supply failure. At this point a single PSU can carry the load of the whole shelf. As a further protection against power failure, each power supply can be optionally powered from independent AC sockets mounted in the I/O plate at the rear of the shelf.

The power supplies are rated at 180 watts.

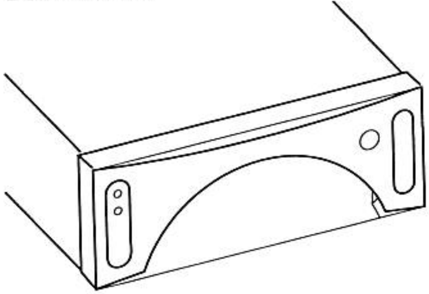
Figure 2-17. Power Supply Unit



Device Carrier

Devices are housed in two types of carriers - one for SCA devices and the other for non-SCA devices. It is essential that you have the correct device carrier type. The non-SCA device carrier is easily identified by the presence of an adapter built into the device carrier which provided SCA attachment of standard 3.5" devices. The top LED on the device carrier indicates SCSI activity on the device and is green. The bottom LED is red and indicates a fault condition. A front view of the device carrier is shown in Figure 2-18.

Figure 2-18. Device Carrier



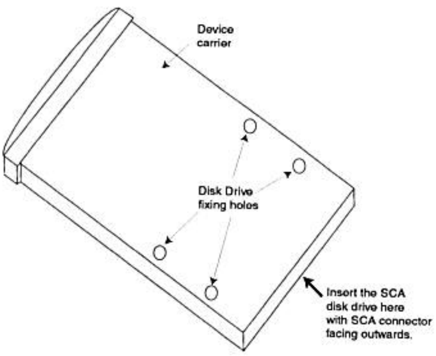
SCA Attachment

To connect an SCA device to a device carrier simply insert the device and connect the device via the 4 screw holes provided on the underside of the device carrier.

Non SCA Attachment

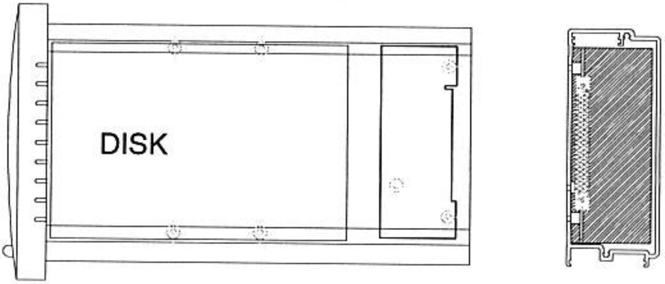
Attaching and removing a non-SCA device is similar to connecting an SCA device but first attach the adapter to the drive and then insert the drive complete with adapter into the device carrier.

Figure 2-19. Attaching a device to an SCA device carrier


Device carrier
Disk Drive fixing holes
Insert the SCA disk drive here with SCA connector facing outwards.

The adapter shuttle interfaces a standard SCSI device (with a narrow 50W or wide 68W connector) to the Voyager series of storage towers. It supports delayed spinup and spindle synchronized modes of operation. The adapter can supply termination power to a device if required. The adapter PCB is designed to fit at the end of the shuttle as shown in Figure 2-20.

Figure 2-20. Non-SCA device adapter



There are also device carriers for other devices (see Table 2-4).

Table 2-4 Device carrier and part numbers

Description	Part Number
Device carrier Standard 3.5" drive (Narrow)	VOY-N-AA
Device carrier Standard 3.5" drive (Wide)	VOY-W-AA
Device carrier Standard 3.5" SCA drive	VOY-SCA-AA
Device carrier for Barracuda 4 drive	VOY-SCB-AA

Power Options Board

NOTE: This is present on earlier models of the Voyager 5000. Later models feature the EMU (see Chapter 3) as standard.

The Power Options Board provides RS-232 communication between the controller and a terminal. It also has a four way DIP switch. The relevant switch settings are shown in Table 2-5.

Table 2-5 Power Options Board Switch Definitions

SW1-4	SW1-2 SW1-3	SW1-1
Sync Link (default is off)	Termination Power Enable (default is on)	Delay Enable (default is on)

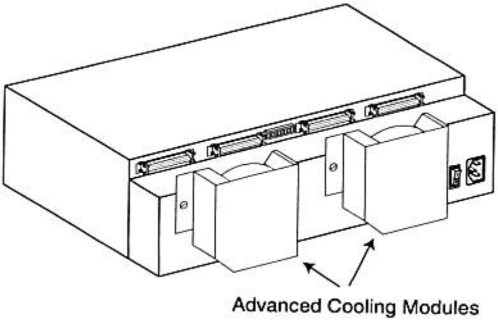
SW1-4 is used to configure the spindle synchronization line across both SCSI buses. The default setting is off. SW1-2 and SW1-3 are used to provide Termination Power and will normally be set to on. SW 1-1 is used to delay the spin up cycle and is normally set to on. In the case of a single power supply delayed spin up will take place. In the case of dual power supply configurations no delay will take place regardless of the setting. The power delay will allow a staggered spin up of the second group of drives within each shelf.

Advanced Cooling Modules

The Advanced Cooling Modules are accessed from the rear of the cabinet. The ACMs are supplied as complete units. Do not attempt to disassemble beyond the FRU level. Refer to Figure 2-21 and remove the ACMs by unscrewing the large single screw, swinging back and unclipping the snap-on wiring connector.

This method provides a quick and easy way to remove a faulty ACM unit without any disruption to system operation.

Figure 2-21. Rear view of ACM Assembly



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Chapter 3: Environmental Monitoring Unit

Introduction

The Environmental Monitoring Unit (EMU) is a multifunction plug-in daughter card that allows a user to monitor the operational status of a Voyager 5000 storage system. There is one EMU per storage shelf. The module provides visual and audible feedback of events to the user. In addition the EMU provides addressable memory locations which may be read or written to. This allows more comprehensive monitoring and reporting to intelligent agents such as Eurologics Vision software. The EMU specification is based on the SAFTE (SCSI Accessed Fault Tolerant Enclosures) specification, and contains many of the features detailed there.

EMU Features

- Monitors presence and status of Fans and Power Supply Units (PSUs).
- Monitors presence of SCSI devices.
- Monitors UPS status and presence.
- Indicates error conditions visually and audibly.
- Adjustable over-temperature warning.
- Stores insertion counts for all removable devices - PSU, Fan, SCSI Device.
- Communication via serial RS232 port or via I^2C bus.
- Fully compatible with Eurologic's Vision software.

The EMU is a flexible unit which may be configured in a variety of ways. It connects to a host system via an RS232 link. Up to eight EMUs may be cascaded together in a Master/Slave configuration. Each EMU is set up to have a distinct ID. A device having an ID of 0 will be a Master, all other devices are designated as Slaves. Multiple EMUs are daisy chained together via an I^{2}C bus.

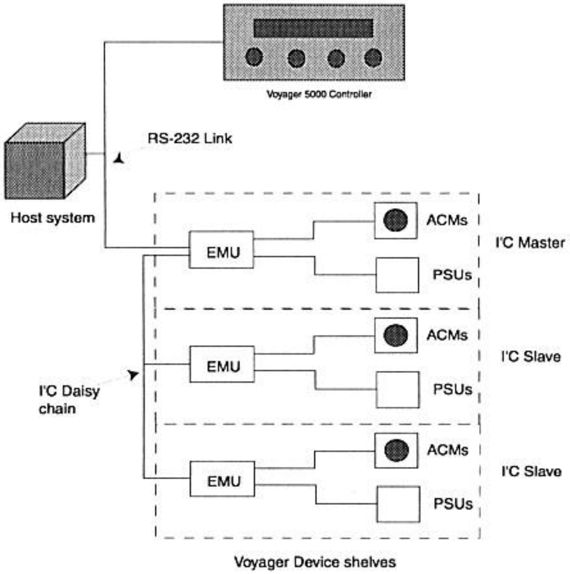
The EMU stores data in a non-volatile EEPROM memory so it is possible to track changes in the system even if power has been removed. On power up the EMU compares the physical system configuration to that stored in memory and notes any changes. These changes will be reported to the host. it is the responsibility of the host to process this information.

System Configurations

The Voyager 5000 storage system consists of a multiple shelf configuration. Each shelf in the system will have an EMU installed as standard. In a multiple shelf configuration the host connects to the I^{2}C Master via RS232 serial link. This RS232 link is also connected to the controller of the Voyager 5000 system. Data from the other EMUs is requested via the I^{2}C bus and is passed to the host via the RS232 link. The I^{2}C Master has sufficient memory to store its own status information. A unique I^{2}C address is assigned to each EMU with the address 0 reserved for the Master. The EMU has provision to support up to eight shelves.

Below is a diagram showing how the EMU is connected in a multiple shelf Voyager 5000 system. The diagram shows how the RS232 link connects to both the host system and to the Voyager 5000 controller.

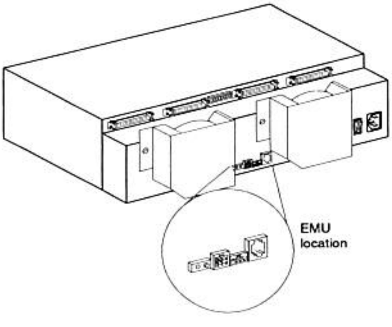
Figure 3-1. Multiple Shelf EMU Configuration



Setting up the EMU

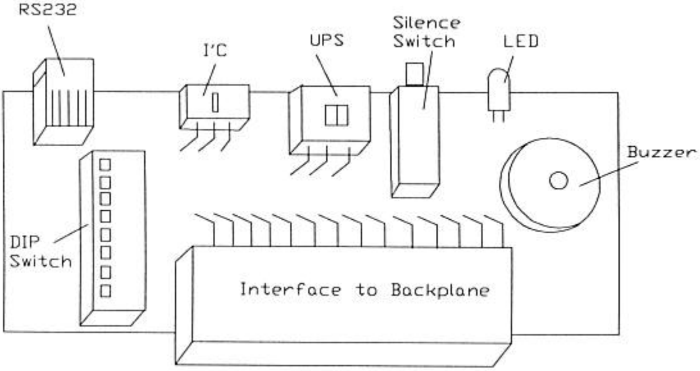
The EMU is physically located at the rear of the device shelf. A magnified view of the EMU is shown in Figure 3-2.

Figure 3-2. Location of EMU within the shelf



A view of the EMUs PCB is shown in Figure 3-3.

Figure 3-3. EMU PCB Layout



The switch settings for the Dip. Switches shown in Figure 3-3 above are given in Table 3-1.

Table 3-1 EMU Switch Settings

Switch	Signal Name	Description	Default Setting
SW1	ID2	Address Bit 2	Setting is position dependent
SW2	ID1	Address Bit 1	
SW3	ID0	Address Bit 0	
SW4	Sync.	Spindle Sync	Off
SW5	DLYSEN	Drive Spinup Enable	On
SW6	DLYSON	Drive Spinup Delay	Off
SW7	Term Pwr 1	Termination Power Enable Bus One	On
SW8	Term Pwr 2	Termination Power Enable Bus Two	On

SW1 --> SW3 are used to set the I^2C bus ID. A device with address 0 is designated as a Master. Any other ID caused the EMU to appear as a Slave device. Table 3-2 shows the EMU ID settings.

Table 3-2 ID settings for the EMU

SW1	SW2	SW3	EMU ID
Off	Off	Off	0 (Master)
Off	Off	On	1
Off	On	Off	2
Off	On	On	3
On	Off	Off	4
On	Off	On	5
On	On	Off	6
On	On	On	7

SW4 is used to enable drive spindle synchronization.

SW5 and SW6 are used to control drive sequencing. If SW5 is off then power up sequencing is *disabled*. If SW5 is set to ON then power up sequencing will be *enabled* if only one PSU is available[1] otherwise no power sequencing will occur.

If SW6 is ON then delayed power sequencing will always occur regardless of the setting of SW5. Table 3-3 summarizes these signals.

Table 3-3 Power Sequencing Signals

SW5	SW6	Action
Off	Off	No delayed power sequencing
On	Off	Power dequencing if only 1 PSU is available
X	On	Delayed power sequencing

X = Don't Care

---

[1] This may occur if a PSU has failed or the system has been set up with only one PSU configured.

SW7 enables SCSI Termination power for bus one and SW8 enables Termination power for bus two.

Available EMU Information

More comprehensive information is provided to intelligent agents such as Eurologic's Vision software. Configuration, warning and status information is available from all EMU's. The single EMU Storage System will provide the data shown in Table 3-4 and Table 3-5.

Table 3-4 Read only memory locations within the EMU

Data Name	Number of Information Bytes
EMU Part No.	4 bytes
EMU firmware rev.	2 bytes
EMU serial No.	4 bytes
EMU power cycle count	2 bytes
Status byte	2 bytes
EMU available	2 bytes
EMU attention	2 bytes
Local temp.	2 bytes
EMU data	8 bytes
Fan insertion count	2 bytes per fan
PSU insertion count	2 bytes per PSU
SCSI device insertion count	2 bytes per SCSI device

Table 3-5 Read/Write locations within the EMU

Data Name	Number of Information Bytes
Master	12 bytes
Alarm temperature	2 bytes
Critical temperature	2 bytes
Action byte	2 bytes
SCSI device status	2 bytes
Power supply control &status	2 bytes
Fan status	2 bytes

Each slave will have the same data available to the Master and host as shown in Table 3-4 and Table 3-5. Table 3-6 shows a summary of the status that is monitored by the EMU.

Table 3-6 Devices/events monitored by the EMU

Connection	Status	Method used
Fans	Connected	Loopback circuit
	Speed OK	Squarewave proportional to speed
PSU	Connected	Loopback circuit.
	Voltage good	Valid if both 12V and 5V good signals are active. Voltages monitored internally by the PSU.
Temperature	Within range	Temperature trip points set in ^{o}C by EMU Circuitry.
SCSI devices	Connected	Loopback circuitry.
	IDs	Read ID settings serially from backplane
Battery backup or UPS	On battery power 2 minute reserve warning	Internal and external logic level connectors.

Interpreting the EMU LED Feedback

When a failure occurs an audible alarm will sound from the buzzer and the EMU LED will flash at regular intervals. Table 3-7 shows how to recognize failures.

Table 3-7 Interpreting the EMU LED feedback

No. of flashes	Interpretation
1	Fan One Failure
2	Fan Two Failure
3	Fan Three Failure
4	Fan Four Failure
5	Alarm temperature
5	Critical temperature reached or exceeded

If a device failure occurs then the bottom light indicator will display RED indicating which device has failed. If a power supply failure occurs then the indicator will display RED.

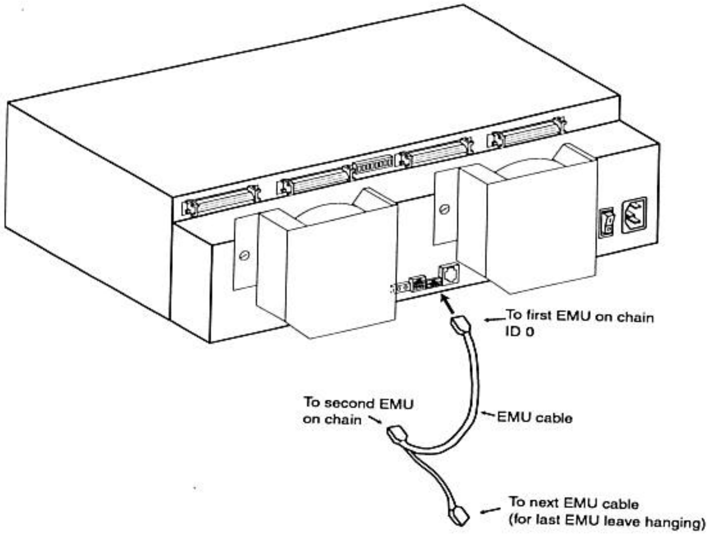
The silence switch is used only to silence the alarm buzzer - it does not stop the error LED from flashing. Multiple failures are shown as multiple sequences of LED flashes, for example if the first two fans fail, then the LED will flash once, followed by two flashes and it will continue to display this sequence.

Connecting the EMU

This section describes the procedure for connecting the EMU to the host system. It is possible to have up to eight EMUs connected together in a daisy chain configuration. The first EMU on the chain must be connected to the host system using the serial RS232 cable provided. The EMU ID for the first shelf in the chain **must** be set as ID 0 so that the system will see it as the Master. All other EMUs connected to the chain will be seen by the system as Slaves.

The EMUs should be daisy chained together using the EMU cable provided (3 connectors). The top connector of the EMU cable should be attached to the 3 pin connector on the EMU. The middle connector of the EMU cable should be connected to the next shelf on the chain. To the bottom connector on the EMU cable connect the top connector of the second EMU cable provided. Connect the middle connector of the second EMU cable to the third EMU on the chain. Continue this procedure until all the EMU's (up to max. of 8) have been connected together. Figure 3-4 shows how to connect the EMUs together.

Figure 3-4. Connecting the EMUs together



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Chapter 4: Installation and Upgrade

Unpacking and Initial Setup

On receipt of the system visually inspect the exterior of the packaging for any signs of damage. If any damage is found the carrier and Eurologic must be notified immediately who will advise you of the appropriate action. The cartons are sealed using packaging tape which should be cut open in the normal manner. Remove the top foam layer from each box and exercise caution when lifting out the components. At this point the contents should be verified against the packing list and Eurologic should again be notified if any discrepancies exist. The devices and power supply units are packaged in anti-static packaging and anti-static precautions must be observed prior to removal. The devices and power supply units can now be inserted into the shelves.

Prior to applying system power verify that the SCSI IDs are set up correctly as described in *Setting the SCSI IDs* and that there is no conflict with any other devices on the SCSI bus.

Recommendations for Installation of Voyager Rackmount systems in Standard 19" Racks

It is essential that the following guidelines be complied with to ensure the safe and efficient operation of Voyager rackmount computer equipment. Eurologic's rackmount systems may be installed in closed or open rackmount systems by observing the environmental, electrical and mechanical precautions listed in the following sections.

Ambient Temperature

Installation of rackmount systems in standard 19" cabinetry may lead to a differential between the room ambient temperature and the internal ambiet temperature of the rack environment. The maximum operating temperature of the Voyager 5000 is 40 degrees Centigrade, however, it is not recommended that the system be continuously run at these elevated temperatures. Consideration should therefore be given to ensuring that the room ambient is compatible with these specifications.

Air Flow

To ensure that the internal heat build up is adequately dissipated into the room environment, air flow should in no way be restricted. It is essential that no vents or ducts are blocked and that the system is a minimum of 1 meter away from a solid surface such as a wall or partition. Airflow through the Voyager shelves is from front to rear.

Mechanical Loading

Consideration should be given to the loading of the cabinet. To maintain a low center of gravity (thus reducing the likelihood of instability) racks should be installed (where possible) from the bottom of the cabinet upwards. This is essential to ensure personal safety. Once the Voyager 5000 system has been put into position the levelers on the bottom of the cabinet must be lowered to the ground. This is to ensure stability and personal safety.

Electrical Considerations

Circuit Overloading

Care should be taken to ensure that the current does not exceed the rating of the power source circuitry. This includes cabling, power distribution units, filters and any other components through which the main AC flows. The power requirements of the Voyager shelf is 1 Amp @ 200 Volts and 2 Amps @ 100 Volts[1] and must be added to the power demands of any other electrical devices installed in the cabinet to arrive at a total power consumption figure. In addition surge currents must be catered for. Disk devices normally consume twice the amount of current at start up time as they do during steady state operation.

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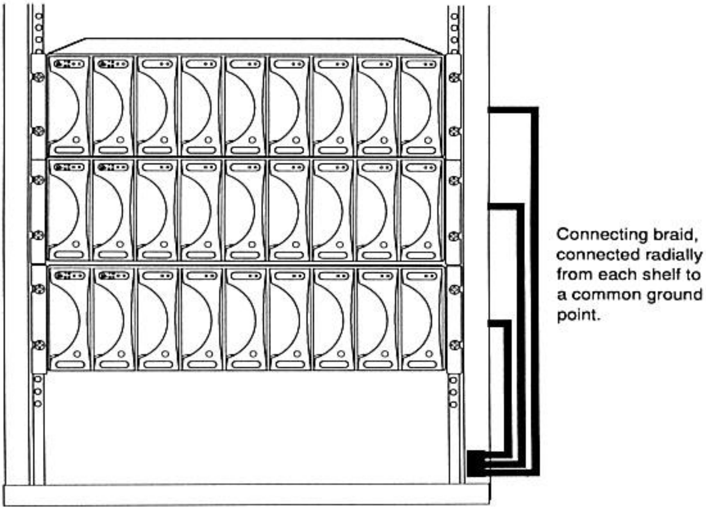
[1] This figure may vary slightly depending on the redundancy mechanisms incorporated, the number of device bays occupied and the device type occupying the bays.

Grounding

Eurologic recommends that all rackmount shelves be grounded to a common point in the cabinet in a radial topology as shown in Figure 4-1.

Figure 4-1. Grounding shelves within a cabinet


Connecting braid, connected radially from each shelf to a common ground point.

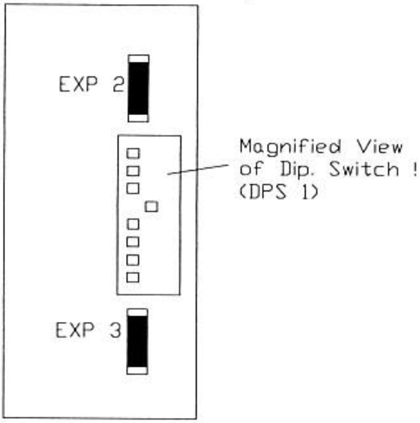
A point for securing a braid is provided at the rear of the rack.

Setting the SCSI IDs

This section refers to the configuration of the SCSI target bus IDs on the backplane. For information relating to setting up the host ID refer to Chapters 5 & 6. The backplane within the disk shelves can be configured as a single SCSI bus or may be split into two SCSI buses. A Voyager 5003 is configured as three shelves with each shelf split into two buses. Voyager 5005 and 5006 models are configured as single SCSI bus shelves.

There is an eight position switch (DPS1) mounted on the backplane and it is used to set the SCSI IDs of both target buses. The switches which are accessible from the rear of the units and sets the base SCSI IDs for each bus. Figure 4-2 shows the location of the switch on the backplane.

Figure 4-2. Location of DPS1 on Backplane



Switch positions 1 - 4 are used to set the starting ID for the first device (Bay 0) on the bus. Devices in bays 1, 2 and 3 will automatically increment this ID by one in turn[2]. For example if the device in bay 0 is set to be at SCSI ID 0 then the device in bay 1 will automatically appear as ID 1, the device in bay 2 will appear as ID 2 and the device in bay 3 will appear as ID 3. Where a backplane is configured as a single bus the device will occupy SCSI IDs 0 - 6 where the device at ID 0 is at the right hand side of the rack as shown in Figure 4-3.

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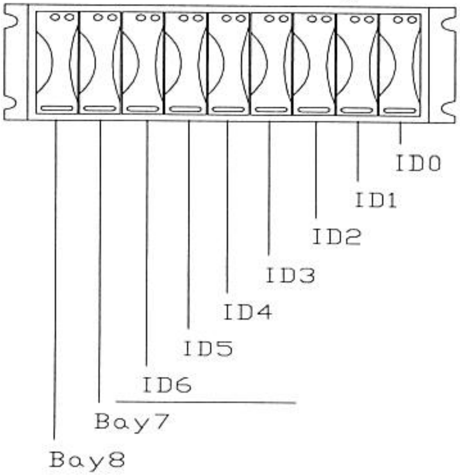
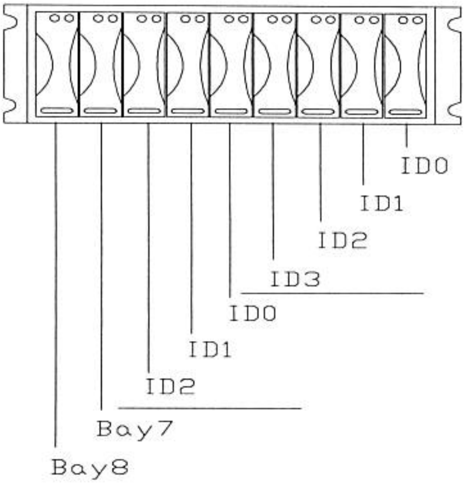
[2] If the starting address is at 15 then the subsequent IDs will *roll over* so that the second drive will take SCSI ID 0, the third drive ID 1 etc.

Figure 4-3. SCSI ID allocation in single bus shelf



The default setting of the switchpack - DPS1 for a shelf configured as a single SCSI bus is shown in Figure 4-4.

Figure 4-4. SCSI ID allocation in a dual bus shelf



In the case of a shelf split into two buses (which is standard in the VRA-5003) the IDs are set at 0 - 3 in the first section and 0 - 2 in the second section as shown in Figure 4-5.

Figure 4-5. Default switch settings for a single SCSI bus configuration

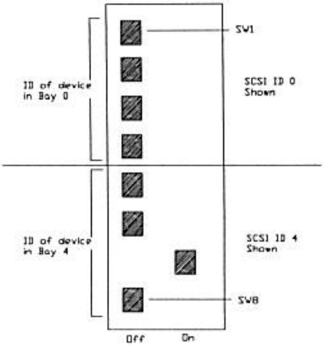
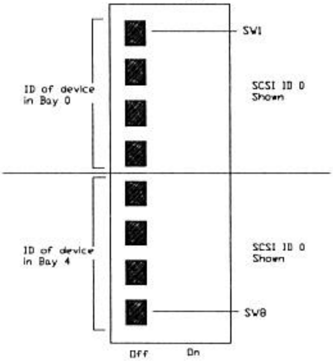


Figure 4-6 shows the default switch settings for a shelf configured as a dual SCSI bus.

Figure 4-6. Default switch setting for a dual SCSI bus configuration



SW-1 of DPS1 corresponds to the L.S.B. of the ID of the device in bay 0, whilst SW-4 corresponds to the M.S.B. of the ID of the device in bay 0. SW-5 of DPS1 corresponds to the L.S.B. of the device in bay 4, whilst SW-8 corresponds to the M.S.B. of the ID of the device in bay 4. As there are four switches the switch positions are arranged to allow 16 possible IDs from 0 - 15.

Table 4-1 shows how to set the SCSI target bus IDs. It will not normally be necessary to alter these from their factory settings.

Table 4-1 SCSI ID switch settings

SW1	SW2	SW3	SW4	Bay 0 device SCSI ID
Off	Off	Off	Off	0
On	Off	Off	Off	1
Off	On	Off	Off	2
On	On	Off	Off	3
Off	Off	On	Off	4
On	Off	On	Off	5
Off	On	On	Off	6
On	On	On	Off	7
Off	Off	Off	On	8
On	Off	Off	On	9
Off	On	Off	On	10
On	On	Off	On	11
Off	Off	On	On	12
On	Off	On	On	13
Off	On	On	On	14
On	On	On	On	15

SW5	SW6	SW7	SW8	Bay 4 device SCSI ID
Off	Off	Off	Off	0
On	Off	Off	Off	1
Off	On	Off	Off	2
On	On	Off	Off	3
Off	Off	On	Off	4
On	Off	On	Off	5
Off	On	On	Off	6
On	On	On	Off	7
Off	Off	Off	On	8
On	Off	Off	On	9
Off	On	Off	On	10
On	On	Off	On	11
Off	Off	On	On	12
On	Off	On	On	13
Off	On	On	On	14
On	On	On	On	15

Drive Geometry

Although a RAID set on the Voyager 5000 appears as one drive to the Host, it is in fact a logical representation of several disk drives. This means that the traditional vocabulary for describing a disk drive's geometry - sectors, heads, and cylinders - has no meaning in the RAID environment. However, for the benefit of operating systems, that require disk geometry information, the Voyager controller reports the following values for sectors, heads and cylinders.

Table 4-2 Reporting the RAID set Geometry

	RAID sets 64 GB and less	RAID sets over 64 GB
Sectors	64	128
Heads	16	128
Cylinders	Divide the total number of blocks in the RAID set by 1024 and drop the remainder.	Divide the total number of blocks in the RAID set by 16384 and drop the remainder.

The sector head values are constant, while the cylinder value varies according to the size of the RAID set. As Table 4-2 shows, the Voyager 5000 uses two different methods for reporting drive geometry: one for RAID sets with capacities of 64 gigabytes and under, and another method for RAID sets over 64 gigabytes.

Cabling and Termination Issues

This section gives guidelines to termination and cable length issues.

Host Cabling

Ensure that the SCSI cable lengths are not exceeded. Refer to Table 4-3 for SCSI cable restrictions. Be sure to include the internal cabinetry cabling to the RAID controller in the calculations.

Table 4-3 SCSI-2 Cable Lengths Vs. Transfer Rates

Length in meters	Transfer Speed
6 Meters	5MHz (10MB/s for wide (16 bit) SCSI-2, 5MB/s for narrow SCSI-2)
3 Meters	10MHz (20MB/s for wide (16 bit) SCSI-2, 10MB/s for narrow SCSI-2)
25 Meters	Differential
3 Meters	20MHz (40MB/s for Wide Ultra)[1]

[1] Ultra SCSI in single ended mode may use 3 meters cable length provided that the device count is no greater than 4. Longer cable lengths may be achieved using Differential Ultra (ELRC-5562).

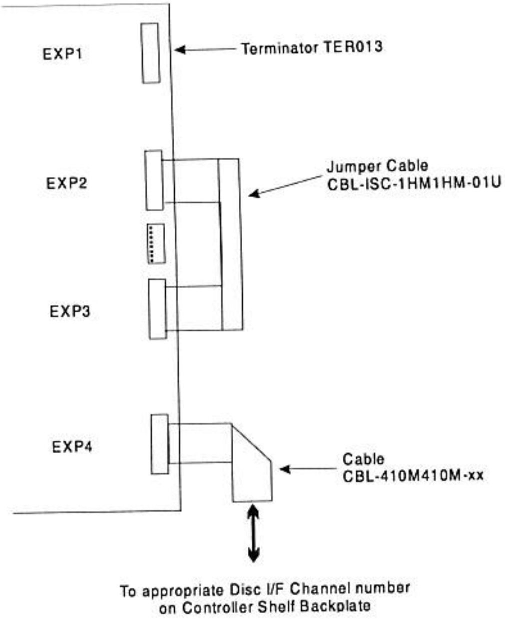
If the host bus is not at the end of a chain then the appropriate terminator must be removed from the host I/F Out connector on the Controller Shelf Backplane (see Figure 4-11). A suitable cable is then added from the host I/F Out connector to the external SCSI devices on the chain.

Once again, ensure that SCSI cable lengths are not exceeded by the total length of the chain (see Table 4-3)

Shelf Cabling for Single Bus Configuration

In single SCSI bus operation the system is terminated at connector EXP1, with a jumper cable (CBL-ISC-1HM1HM-01U) joining connectors EXP2 and EXP3 together as shown in Figure 4-7. A cable (CBL-410M410M-xx) connects EXP4 to the appropriate Disk I/F Channel on the Controller Shelf Backplane (where -xx is the cable length in meters).

Figure 4-7. Backplane Configured for One SCSI bus



Shelf Cabling for Dual Bus Configuration

In dual SCSI bus operation the system is terminated at connectors EXP1 and EXP3. Separate cables (CBL-410M410M-xx) connects EXP2 and EXP4 to the appropriate Disk I/F Channels on the Controller Shelf Backplane (where -xx is the cable length in meters) (see Figure 4-8 & Figure 4-11).

The first SCSI bus runs from connector EXP4 to connector EXP3, and the second bus runs from connector EXP2 to connector EXP1.

Figure 4-8. Backplane Configured for Two SCSI Buses

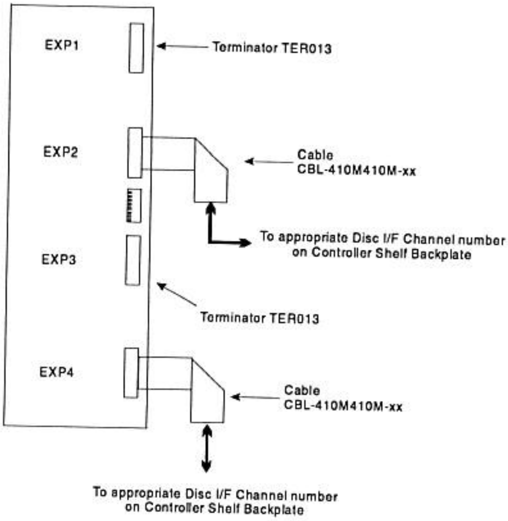
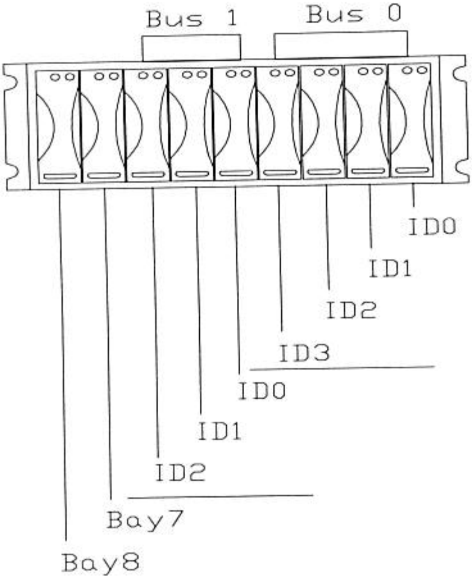

EXP1
Terminator TER013
EXP2
Cable
CBL-410M410M-xx
To appropriate Disc I/F Channel number
on Controller Shelf Backplate
EXP3
Terminator TER013
EXP4
Cable
CBL-410M410M-xx
To appropriate Disc I/F Channel number
on Controller Shelf Backplate

Table 4-4 Voyager Cabling Considerations

Configuration	Internal Action	External Action
Single	Terminate on EXP1. Connect internal cable CBL-410M410M-xx from appropriate Disk I/F to EXP4. Connect internal jumper cable CBL-ISC-1HM1HM-01U between EXP2 and EXP3.	Connect host cable to host I/F 1 on controller shelf back panel.
Dual Bus	Terminate on EXP1 and EXP3. Connect cable CBL-410M410M-xx from appropriate Disk I/F to EXP4. Connect cable CBL-410M410M-xx from appropriate Disk I/F to EXP2.	Use host I/F 1 for SCSI bus 1 and host I/F 2 for SCSI bus 2.

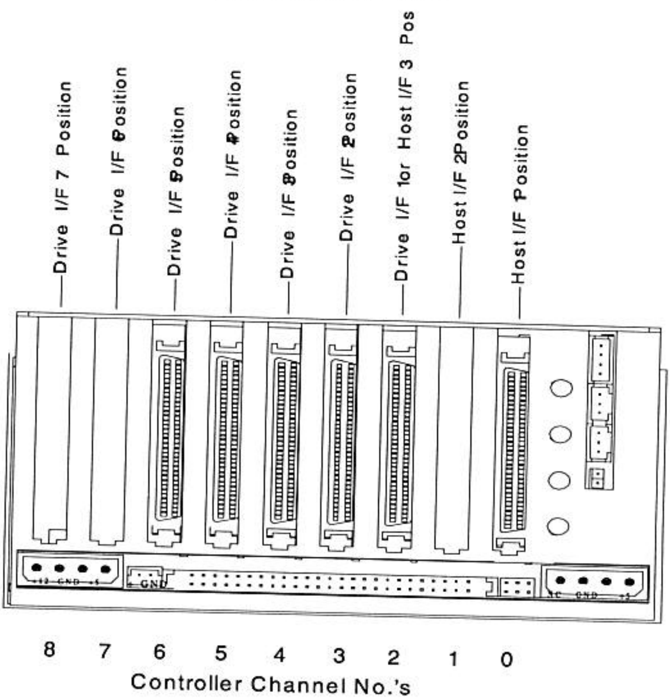
Where a shelf is split into two buses the first bus (designated bus 0) starts at the right hand side when viewed from the front and occupies bays 0 - 3. The second bus occupies bays 4 - 6 as shown in Figure 4-9.

Figure 4-9. Front View of Shelf Showing SCSI Bus Allocation



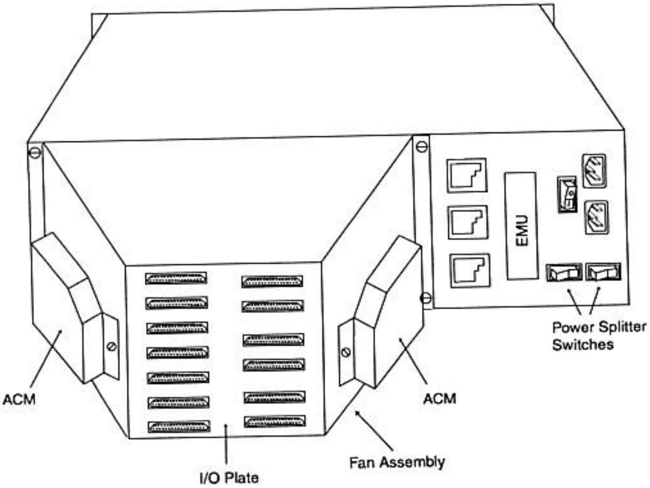
Channels within the RAID controller are designated as channels 0 through 8 (see Figure 4-10). These channel numbers are also referenced on Figure 4-12 & Figure 4-14. Channel 0 is used for the first host channel, and Channel 1 is reserved for use as a second host channel.

Figure 4-10. Rear of Voyager 5000 Controller



The cabling from the RAID controller to the Disk Shelves starts at the first available drive channel. In the case of a single host connection this will be the third channel (channel 2). Disk I/F Channels are connected to the appropriate connectors on the Controller Shelf Backplane, as determined by the configuration. Figure 4-11 shows the Controller Shelf Backplane.

Figure 4-11. Controller Shelf Backplane



If a third host channel is required then this takes over channel 2. In this case, the first drive channel would be 3.

Voyager 5000 Standard Configuration

This section will describe the standard Voyager 5000 configurations. The cabling for each standard configuration is also shown.

VRA-5003D-XX-Y

In the VRA-5003D-XX-Y the first two available drive channels (channels 2 & 3) are connected to the first shelf, the next two available drive channels (channels 4 & 5) are connected to the second shelf and the next two available drive channels (channels 6 & 7) are connected to the third shelf. Figure 4-12 shows the controller shelf backplane layout and Figure 4-13 shows the cabling configuration.

Figure 4-12. Controller Shelf Backplane Layout for VRA-5003

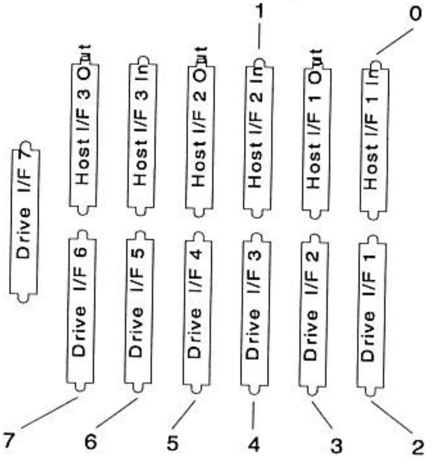
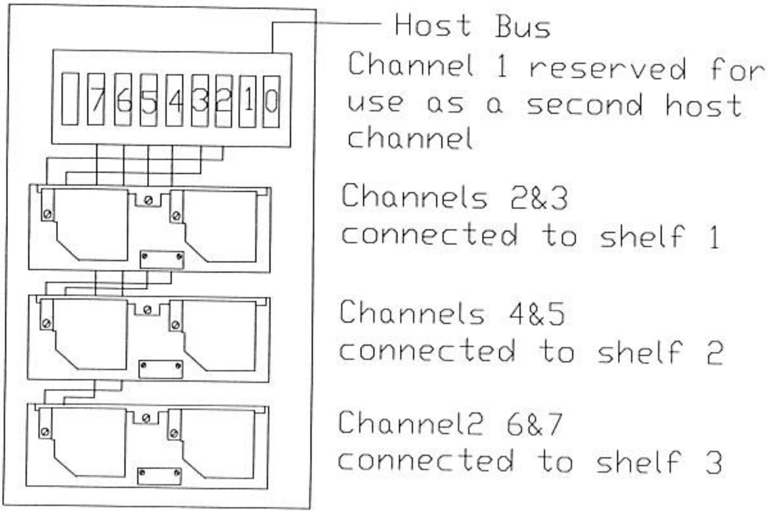


Figure 4-13. Cabling Configuration of a VRA-5003



Channel 1 reserved for use as a second host channel

Channels 2&3 connected to shelf 1

Channels 4&5 connected to shelf 2

Channel2 6&7 connected to shelf 3

A drive shelf split into two buses will be arranged so that the first bus within a shelf is connected to the first of the pair of drive channel cards. The first four drives taking up SCSI ID's 0 to 3 are assigned to bus 0 and the next three drives taking up SCSI IDs 0 to 2 are assigned to bus one. Table 4-5 shows how a single host VRA-5003 model is set up

Table 4-5 Drive Channel Card Assignments for a VRA-5003

Shelf No.	Bus No.	Channel Card No.	Drive SCSI ID range
1	0	2	0 - 3
1	1	3	0 - 2
2	0	4	0 - 3
2	1	5	0 - 2
3	0	6	0 - 3
3	1	7	0 - 2

NOTE: The cable configuration drawings in these sections relate the Disc Shelf to Channel Number within the controller. The physical routing of cables from the shelf to the controller is via the Controller Shelf Backplane.

VRA-5005D-XX-Y

For the VRA-5005D-XX-Y the first drive channel is connected to the first disk shelf, the second drive channel is connected to the second shelf, the third drive channel is connected to the third shelf, the fourth drive channel is connected to the fourth shelf and the fifth drive channel is connected to the fifth shelf. Figure 4-14 shows the controller shelf backplane layout and Figure 4-15 shows the cabling configuration.

Figure 4-14. Controller shelf Backplane Layout for VRA-5005

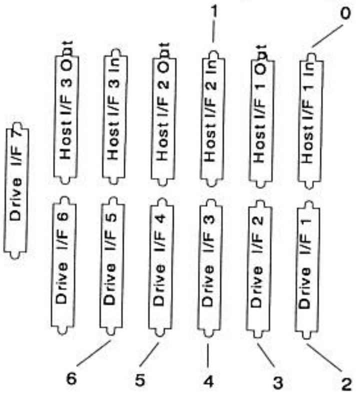
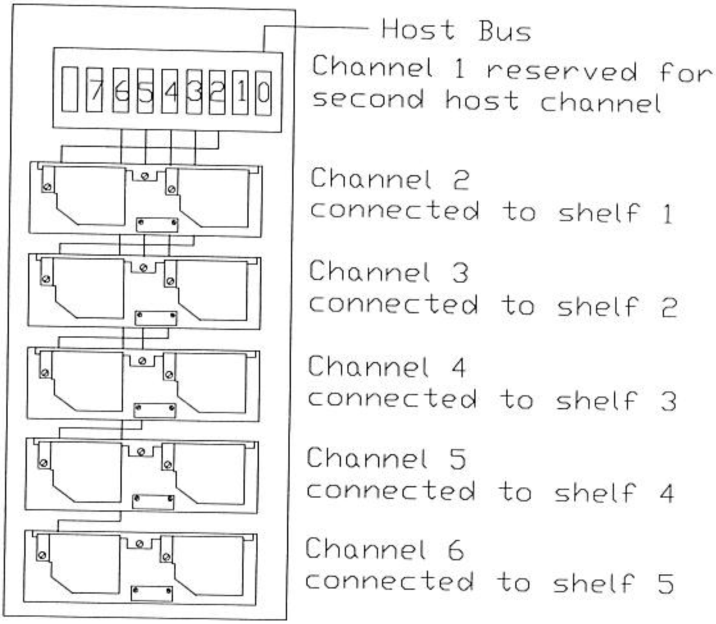


Figure 4-15. Cabling Configuration of a VRA-5005



Host Bus

Channel 1 reserved for second host channel

Channel 2 connected to shelf 1

Channel 3 connected to shelf 2

Channel 4 connected to shelf 3

Channel 5 connected to shelf 4

Channel 6 connected to shelf 5

Each shelf is configured as one SCSI bus and takes up SCSI IDs 0 to 6. Table 4-6 shows the channel assignments for the VRA-5005.

Table 4-6 Drive Channel Card Assignments for a VRA-5005

Shelf No.	Bus No.	Channel Card No.	Drive SCSI ID range
1	0	2	0 - 6
2	0	3	0 - 6
3	0	4	0 - 6
4	0	5	0 - 6
5	0	6	0 - 6

VRA-5006D-XX-Y

For the VRA-5006D-XX-Y the first drive channel is connected to the first shelf, the second drive channel is connected to the second shelf, the third drive channel is connected to the third shelf, the fourth drive channel is connected to the fourth shelf, the fifth drive channel is connected to the fifth shelf and the sixth drive channel is connected to the sixth shelf. Figure 4-16 shows the controller shelf backplane layout and Figure 4-17 shows the cabling configuration.

Figure 4-16. Controller Shelf Backplane layout for VRA-5006

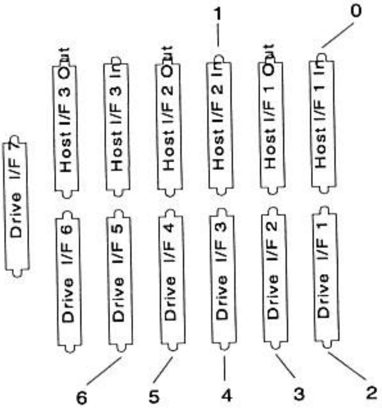
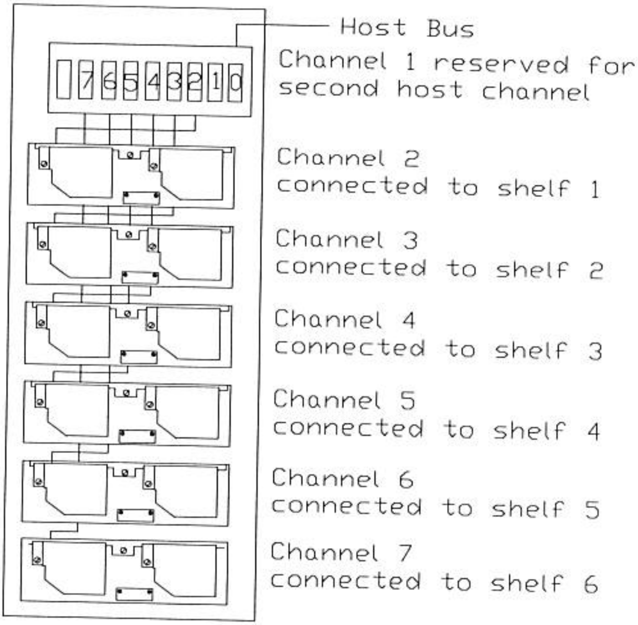


Figure 4-17. Cabling Configuration of a VRA-5006


7 6 5 4 3 2 1 0
Host Bus
Channel 1 reserved for second host channel
Channel 2 connected to shelf 1
Channel 3 connected to shelf 2
Channel 4 connected to shelf 3
Channel 5 connected to shelf 4
Channel 6 connected to shelf 5
Channel 7 connected to shelf 6

Each shelf is configured as one single SCSI bus and it takes up SCSI IDs 0 to 6. Table 4-7 shows the drive channel card assignments.

Table 4-7 Drive Channel Card Assignments for a VRA-5006

Shelf No.	Bus No.	Channel Card No.	Drive SCSI ID range
1	0	2	0 - 6
2	0	3	0 - 6
3	0	4	0 - 6
4	0	5	0 - 6
5	0	6	0 - 6
6	0	7	0 - 6

Multiple Host Configurations

In the case of a Dual Host system the first available drive channel in the controller will be Channel 2 (see Figure 4-10) and channel designations for the drives will remain the same as in the case for a single host attachment (see Figure 4-12).

In a Triple Host configuration, however, the third channel (channel 2) will be used as a host attachment and each drive channel will be moved up one position. The controller shelf backplane connections for a 5003 with three host channels are shown in Figure 4-18 and the cabling configuration is shown in Figure 4-19.

Figure 4-18. Controller Shelf Backplane Layout for Triple Host 5003

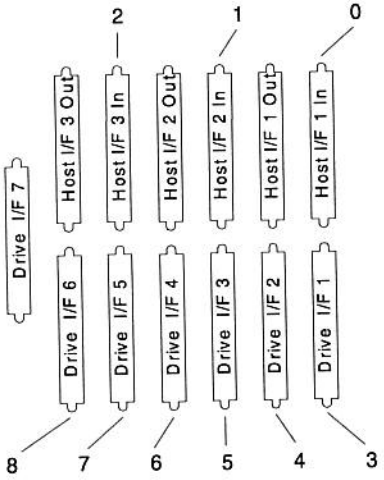
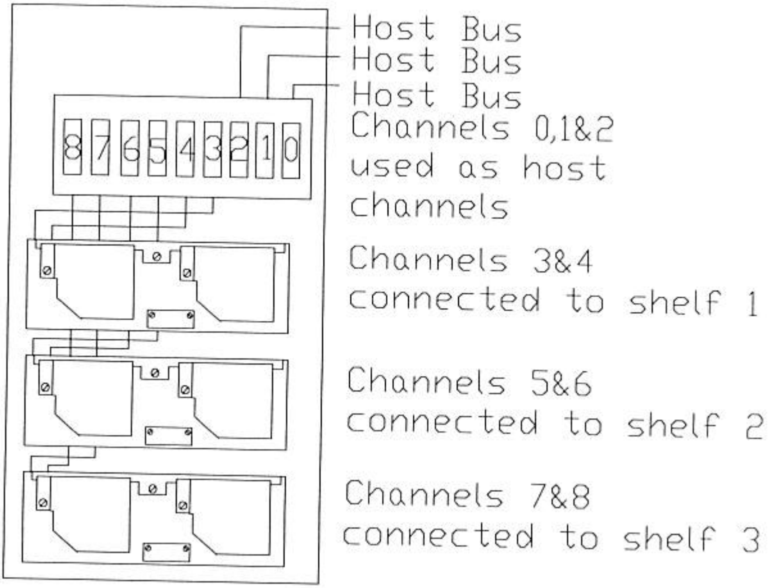


Figure 4-19. Cabling Configuration of 5003 with 3 Host Channels


Host Bus
Host Bus
Host Bus
8 7 6 5 4 3 2 1 0
Channels 0,1&2 used as host channels
Channels 3&4 connected to shelf 1
Channels 5&6 connected to shelf 2
Channels 7&8 connected to shelf 3

For the 5003 with 3 host channels the following would be the drive channel card assignments.

Table 4-8 Drive Channel Card Assignments for 3 Host VRA-5003

Shelf No.	Bus No.	Channel Card No.	Drive SCSI ID range
1	0	3	0 - 3
1	1	4	0 - 2
2	0	5	0 - 3
2	1	6	0 - 2
3	0	7	0 - 3
3	1	8	0 - 2

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Chapter 5: Monitor Utility

Connecting a Monitor

The Voyager 5000 is shipped with a serial cable for making the connection to an external monitor. At one end of the cable is a connector compatible with the Voyager 5000 RJ11 RS232 port located at the rear I/O plate.

To use the monitor utility, run the cable from the Voyager 5000 to your monitor. The terminal should be configured as follows:

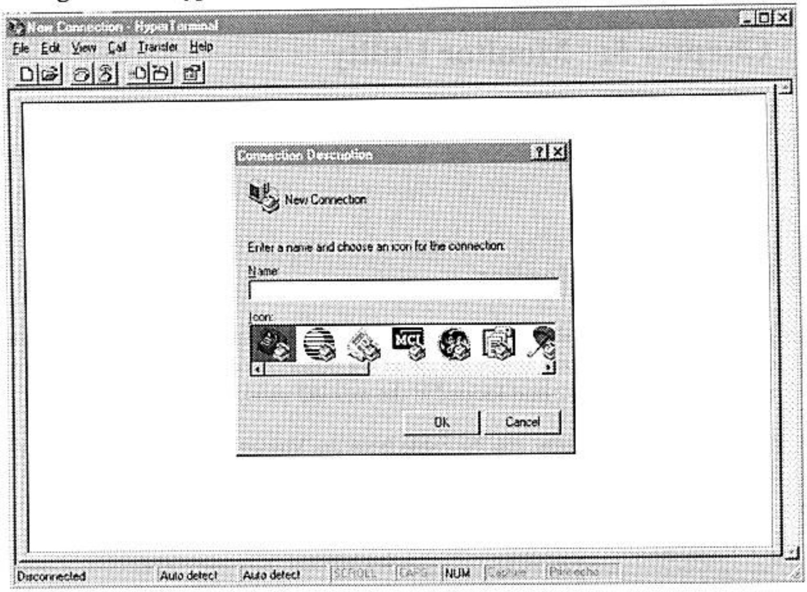
Parameter	Value
Baud Rate	9600
Data Bits	8
Stop Bits	1
Parity	None

Emulating a Monitor

If you do not have a dedicated monitor at your disposal, you can still access the Voyager 5000's monitor utility by using a PC and communications software to emulate a monitor. In this example we will use the Microsoft Windows 95 Hyper Terminal program.

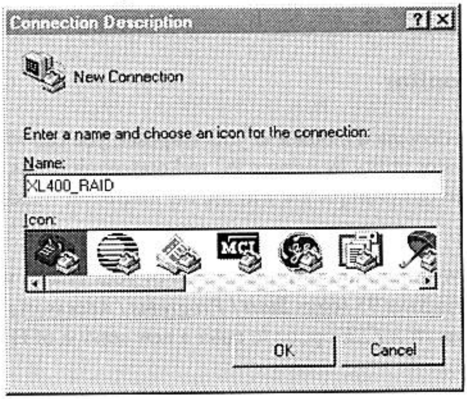
Firstly connect the Voyager 5000 to the serial port of your system with the cable supplied. Then in Windows 95 select *Start / Programs / Accessories / Hyper Terminal*. Select the *Hypertrm.EXE* option to enter a new session of Hyper Terminal (see Figure 5-1).

Figure 5-1. HyperTerminal initial screen



Enter a name for the connection in the *Connection Description* dialogue box. In this example the connection is called XL400_RAID (see Figure 5-2).

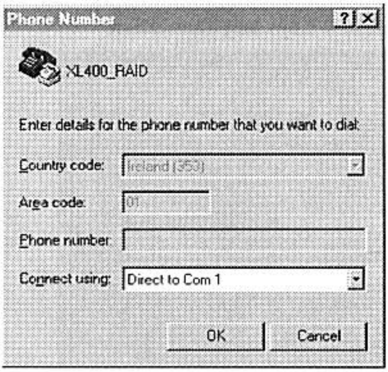
Figure 5-2. Entering a connection name



Name: XL400_RAID

Pressing OK brings up the *Phone Number* window. In the *Connect Using:* pop-up menu select which COM Port the Voyager 5000 is connected to. For example for COM 1 select *Direct to COM 1* (see Figure 5-3).

Figure 5-3. Selecting the COM Port



XL400_RAID

Enter details for the phone number that you want to dial:

Country code: Ireland (353)

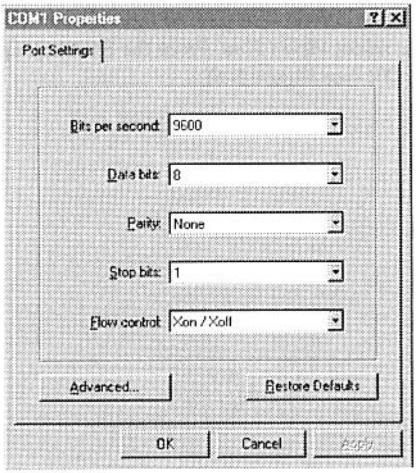
Area code: 01

Phone number:

Connect using: Direct to Com 1

Pressing OK brings up the *COM 1 Properties* window. This window allows you to configure the port settings as shown in the table above (see Figure 5-4).

Figure 5-4. Configuring Port Settings



Bits per second: 9600

Data bits: 8

Parity: None

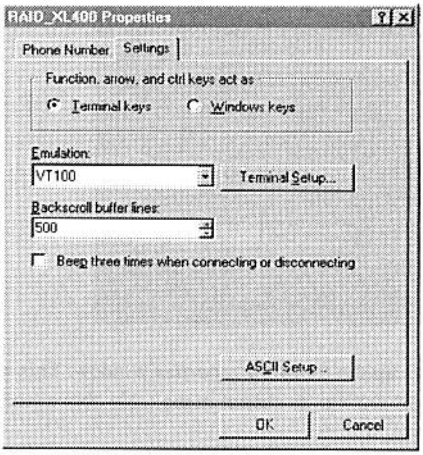
Stop bits: 1

Flow control: Xon / Xoff

Once the port settings have been configured press OK.

From the Main Menu select *File / Properties / Settings*. In the *Function, arrow, and CTRL keys act as"* area select *Terminal Keys*. In the *Emulation* area select *VT100* as the emulation option. Select OK (see Figure 5-5).

Figure 5-5. Setting Terminal Keys and Emulation



RAID_XL400 Properties

Function, arrow, and ctrl keys act as

● Terminal keys ○ Windows keys

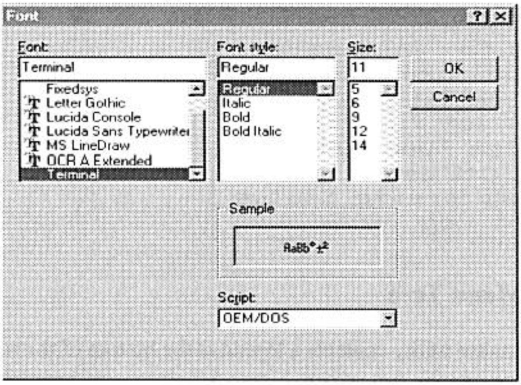
Emulation: VT100

Backscroll buffer lines: 500

☐ Beep three times when connecting or disconnecting

Finally we have to set the correct font to view the Voyager 5000 Monitor Utility. From the Main Menu select *View / Font*. From the *Font* pop-up menu select *Terminal* font and press OK (see Figure 5-6).

Figure 5-6. Setting the Terminal Font



Font: Terminal

Font style: Regular

Size: 11

Script: OEM/DOS

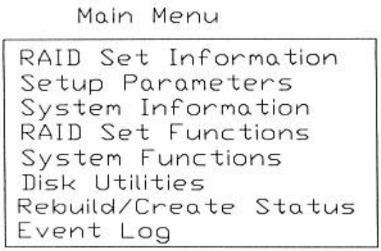
HyperTerminal is now set up to run the Monitor Utility of the Voyager 5000.

The monitor utility provides complete control over the configuration and operation of the controller. You may also use the utility to view the status of the controller's RAID sets and monitor the progress of creates and rebuild operations. An event log screen displays a continuously updated listing of controller events to aid in troubleshooting.

Monitor Utility

The Voyager 5000's monitor utility provides complete control over the configuration and operation of the controller. You may also use the utility to view the status of the controller's RAID sets and monitor the progress of the create and rebuild operations. An event log screen displays a continuously updated list of controller events to aid in troubleshooting. The monitor utility Main Menu is shown in Figure 5-7.

Figure 5-7. Main Menu Screen



```
Main Menu

RAID Set Information
Setup Parameters
System Information
RAID Set Functions
System Functions
Disk Utilities
Rebuild/Create Status
Event Log
```

Navigating the Menu Tree

Each screen in the monitor utility contains a legend at the bottom of the screen with instructions for navigating that screen. Figure 5-8 shows the menus and submenus for the monitor utility.

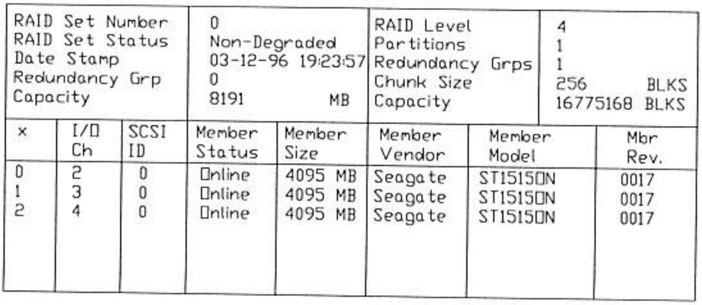
Figure 5-8. Monitor Utility Menu Tree

- **RAID Set Information**
- **Setup Parameters**
  - Host Parameters
    - SCSI ID
    - Tag Queuing
    - Bus Width
    - Mega-Xfers/sec
    - Termination
  - System Parameters
    - Password checking
    - Date
    - Time
    - Rebuild Rate
    - Create Rate
    - UPS
    - Read-Ahead
    - Read-Ahead Limit
    - Validation delay
    - Host Select WCE
  - Host LUN Mapping
  - Caching Parameters
  - Channel Settings
  - Rdnt Ctrlr Parameters
- **System Information**
  - I/O Statistics
  - Free List Statistics
    - Manufacturing Information
    - Environmental Status
    - Transfer Rate Information
    - I/O Process Information
    - Rdnt Ctrlr Information
- **RAID Set Functions**
  - Create RAID Set
  - Rebuild Disk
  - Add Spares
- **System Function**
  - Change Password
  - Load System Code
  - Restart System
  - System Shutdown
  - Download Drive Firmware
- **Disk Utilities**
  - Format Disk
  - Test Disk
- **Rebuild/Create Status**
- **Event Log**

RAID Information

The *RAID Set Information* screen is the heart of the monitor utility and likely will be the screen you find most useful during operation of the controller. This screen provides a continuously updated report on the status of your RAID set, with information about their parameters, drive configuration and condition. An example of the *RAID Set Information* screen is given in Figure 5-9.

Figure 5-9. RAID Set Information Screen



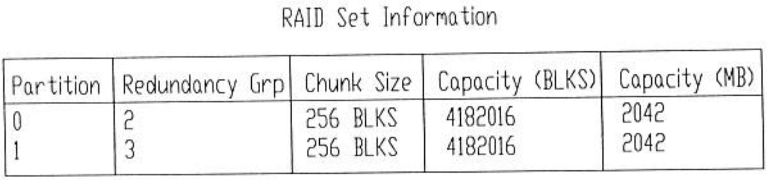
```
RAID Set Number       0                   RAID Level          4
RAID Set Status       Non-Degraded        Partitions          1
Date Stamp            03-12-96 19:23:57   Redundancy Grps     1
Redundancy Grp        0                   Chunk Size          256       BLKS
Capacity              8191          MB    Capacity            16775168  BLKS

x    I/O   SCSI   Member    Member     Member     Member       Mbr
     Ch    ID     Status    Size       Vendor     Model        Rev.
0    2     0      Online    4095 MB    Seagate    ST15150N     0017
1    3     0      Online    4095 MB    Seagate    ST15150N     0017
2    4     0      Online    4095 MB    Seagate    ST15150N     0017
```

Use the “N” and “P” keys to page through your RAID sets.

The Voyager 5000 controller supports the partitioning of RAID sets. A partitioned RAID set will have multiple redundancy groups associated with it. Each redundancy group will have its own redundancy group number, which corresponds to the Logical Unit Number (LUN) that the host will address to the partition, unless you map the redundancy group to another LUN with the *Host LUN Mapping Screen* (see Figure 5-13). When you page to partitioned RAID sets, the RAID information will look like that in Figure 5-9 above.

To view the information specific to each partition, press “R” for redundancy group information. An example of the redundancy group information screen is shown in Figure 5-10.

Figure 5-10. Redundancy Group Information



RAID Set Information

Partition	Redundancy Grp	Chunk Size	Capacity (BLKS)	Capacity (MB)
0	2	256 BLKS	4182016	2042
1	3	256 BLKS	4182016	2042

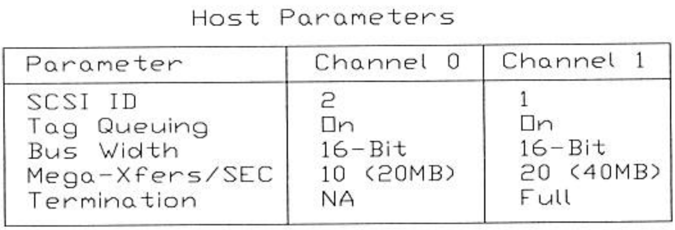
Setup Parameters

This menu option covers the *Host Parameters, System Parameters, Host LUN Mapping, Caching Parameters, Disk Parameters, Channel Settings,* and *Redundant Controller Parameters* menu items. These screens are useful for configuring the controller.

Host Parameters

Use this screen to set the SCSI ID, Synchronous transfer rate and termination for the controller. You may also enable or disable tag queuing here. The number of host channels depicted in the screen adjusts automatically according to the number of I/O modules you have configured as host channels. An example of the *Host Parameters* screen is shown in Figure 5-11.

Figure 5-11. Host Parameters Screen



Host Parameters

Parameter	Channel 0	Channel 1
SCSI ID	2	1
Tag Queuing	On	On
Bus Width	16-Bit	16-Bit
Mega-Xfers/SEC	10 (20MB)	20 (40MB)
Termination	NA	Full

SCSI ID

You must select a unique ID between 1 and 15 for a 16-bit host module, or between 0 and 7 for an 8-bit module. Make sure that the SCSI IDs for the other devices on the host bus, including the host adapter, do not conflict with the ID you set for the Voyager 5000's host module.

Tag Queuing

If your host adapter supports tag queuing you may enable this feature. Tag queuing permits each initiator to issue commands accompanied by instructions for how the target should be executed by the target at the first available opportunity, in the order in which it was received, or at a time deemed appropriate by the target. Tag queuing permits each initiator to have multiple commands outstanding and each target to optimize the commands it receives.

Bus Width

If you are using a 16-bit module, you should set this parameter to 16 Bit. Select 8 Bit if you are using an 8-bit module.

Mega-Xfers/sec

This field lets you specify the synchronous transfer rate. The basic range for the Mega-Xfers is less than 5 and greater that 10. If the host channel module is ULTRA, an additional value of 20 can be selected. Based on the selected bus width and the Mega-Xfers value, the Mega-Xfers are translated to MB and displayed alongside the Mega-Xfers value. All data transfer rates negotiations between the controllers SCSI Initiator code and a drive will be logged in the Event Log as they occur.

Termination

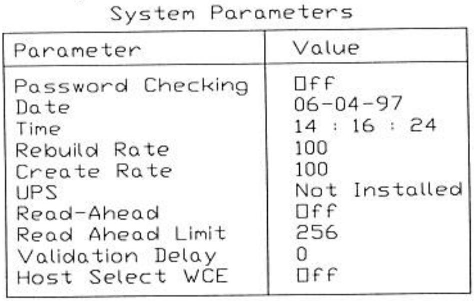
SCSI buses must be terminated at each end. With a 16-bit module, you may select full or partial temination, as well as no termination at all. If the host module is not at the end of the host SCSI bus, select no termination. If the host module is the last module on the bus, select full termination. Select partial termination if the host module is the last 16-bit device on the bus, but additional 8-bit devices are connected to the bus after the host module. Partial termination terminates only the eight highest lines of the 16-bit SCSI bus and permits the lower eight lines to continue on the bus.

NOTE: When you change host parameters, you must use the *Restart System* option from the *Systems Functions* menu to have the changes take effect.

System Parameters

Use this screen to configure password checking, and set the date and time of the controller's system clock. This screen also sets the rates for rebuilds and creates. An example of this screen is shown in Figure 5-12.

Figure 5-12. System Parameters Screen



System Parameters

Parameter	Value
Password Checking	Off
Date	06-04-97
Time	14 : 16 : 24
Rebuild Rate	100
Create Rate	100
UPS	Not Installed
Read-Ahead	Off
Read Ahead Limit	256
Validation Delay	0
Host Select WCE	Off

Password Checking

Enables or disables password checking. When password checking is enabled, the controller will limit access to the monitor utility unless the user enters the correct password. Without the correct password, the user will be able to see only RAID Set Statistics, Rebuild/Create Status and Event Log screens. Once you have turned password checking on, the controller will prompt for a password the next time you try to enter the monitor utility.

Date

Use this option to set the system date. Once you set the date, the controllers internal clock will keep the date current. This date is displayed on most monitor screens, and, more importantly, is stamped on all event log entries. To set the date, use the arrow keys to highlight the date field. Switch to edit mode by pressing Enter. Then use the left and right arrow keys to move between the day, month and year fields, and the up and down arrow keys to spin the selected field up and down.

Time

Use this option to set the system time. Once you set the time, the controllers internal clock will keep the time current. This time is displayed on most monitor screens, and, more importantly, is stamped on all event log entries. To set the time, use the arrow keys to highlight the time field. Switch to edit mode by pressing Enter. Then use the left and right arrow keys to move between the hour, minute and second fields, and the up and down arrow keys to spin the selected field up and down.

Rebuild Rate

The controller will rebuild RAID sets at the same time it handles I/O activity from the host. The relative priority the controller gives to rebuilds on the one hand and I/O activity on the other is determined by the *Rebuild Rate*. This rate ranges from 1 to 100. A rate above 50 places a higher priority on rebuilds. Rates below 50 improves I/O responses but causes rebuilds to take place at a slower rate.

Create Rate

As with rebuilds, the controller will perform RAID set creations at the same time it handles I/O activity from the host. Unlike the rebuild, **no** I/O activity may be directed at the RAID set until the create is finished. The relative priority the controller gives to creates on the one hand and I/O activity on the other is determined by the *Create Rate*. This rate ranges from 1 to 100. A rate above 50 places a higher priority on creates at the expense of I/O activity. A rate below 50 emphasizes I/O response over the RAID set creation.

UPS

If you connect an Uninterruptable Power Supply (UPS) to the controller, set this field to “Installed”. This will cause the controller to watch for the “two-minute warning” and “AC power fail” signals from the UPS and act accordingly. If you set this field to “Not Installed”, the controller will not watch for these signals, even if a UPS is connected to the controller. Refer to Chapter 8 for details on backup power and UPS signals.

Read-Ahead

This option allows you to enable or disable read-ahead caching. When read-ahead is turned on, the controller will take in additional data with each read operation. This data will be stored in cache in anticipation that it will be requested in the next read operation. If the data is indeed requested, it can be fetched from cache rather than from the drive. This can greatly improve read performance when you are performing many reads from sequential data. If your data is non-sequential, read-ahead will actually slow read performance, because the controller will be reading extra data unnecessarily. In this case, you should turn read-ahead off.

Read -Ahead Limit

The controller will limit the amount of read-ahead data it takes in to the amount of data left in the current chunk or the amount of data left on the current drive, whichever is smaller. The controller never will read-ahead to another drive, as this would impose an unwanted performance penalty. The user may further limit the scope of read ahead operations by setting the read ahead limit value. This is the maximum amount of data (in blocks) that the controller will read ahead. The controller still will select the smallest value among the read ahead limit, the amount of data left in the current chunk, and the amount of data that can be read without shifting to another drive. You may find that changing the read ahead limit can improve performance if you have selected a large chunk size. The default is 256 blocks.

Validation Delay

This is the length of time (in seconds) that the controller will wait before attempting to validate the disk drives connected to it at power up. If you have disk drives that need extra time to spin up, set the validation delay to a value greater than the time it takes the drives to spin up. Otherwise, when the controller attempts to validate the drives at power up, it will fail to recognize them. You may select a validation delay of as long as 60 seconds.

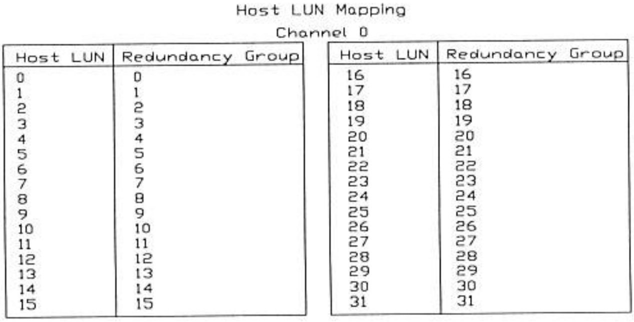
Host Select WCE

This parameter determines whether the host can select and disable write-back caching via the SCSI mode select command. The Voyager 5000 controller achieves best performance when write-back caching is enabled, but certain operating systems automatically disable write-back caching during initialization. If an operating system is set to OFF, and if WCE is ON, then all RAID Sets will operate in Write-Through mode even if you set caching on through the *Caching Parameters* page.

Host LUN Mapping

This screen may be used to map LUNs on each host channel to a particular redundancy group. Or you may prevent a redundancy group from appearing on a host channel. Thus, for example, you may map redundancy group 1 to LUN 5 on host channel 0 and the same redundancy group to LUN 12 on host channel 1. Or you may make redundancy group 8 available on LUN 4 on host channel 0 and block access to it on host channel 1. An example of the *Host LUN Mapping* screen is shown in Figure 5-13.

Figure 5-13. Host LUN Mapping Screen



Host LUN Mapping

Channel 0

Host LUN	Redundancy Group
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15

Host LUN	Redundancy Group
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31

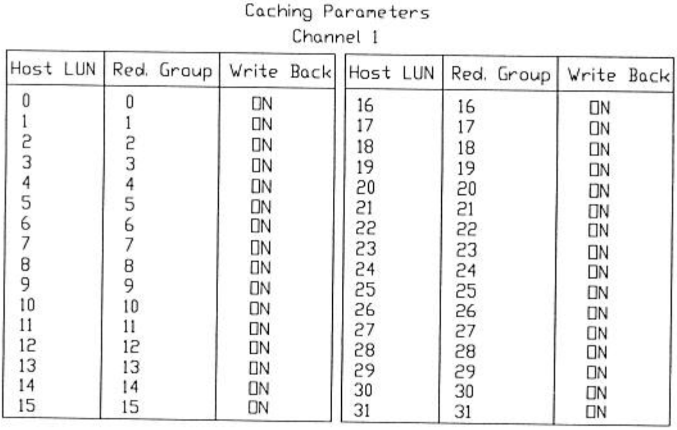
Caching Parameters

The *Caching Parameters* screen allows you to toggle write-back caching on and off for each redundancy group. The Voyager 5000 controller uses write-back caching to enhance performance on write operations by storing write data in cache and signaling to the host that the write is complete before the data is written to disk. The controller completes the write by moving the data from cache to disk during periods of inactivity or when it is forced to complete the write operation to make room for more data.

While write-back caching improves the performance of the controller, it also opens the possibility that data in the cache will be lost during a power failure. A backup battery and/or UPS virtually eliminates this possibility; however, users who require absolute data integrity may wish to disable write-back caching.

To disable or enable write-back caching by redundancy group, press the N or P key to select a host channel. Then use the arrow keys to navigate to a redundancy group. Press the Enter key to edit the field. Press the up or down arrow keys to toggle the field. Press enter again to accept the new value, or Ctrl-Z to abort. An example of the *Caching Parameters* screen is shown in Figure 5-14.

Figure 5-14. Caching Parameters Screen



Caching Parameters
Channel 1

Host LUN	Red. Group	Write Back	Host LUN	Red. Group	Write Back
0	0	ON	16	16	ON
1	1	ON	17	17	ON
2	2	ON	18	18	ON
3	3	ON	19	19	ON
4	4	ON	20	20	ON
5	5	ON	21	21	ON
6	6	ON	22	22	ON
7	7	ON	23	23	ON
8	8	ON	24	24	ON
9	9	ON	25	25	ON
10	10	ON	26	26	ON
11	11	ON	27	27	ON
12	12	ON	28	28	ON
13	13	ON	29	29	ON
14	14	ON	30	30	ON
15	15	ON	31	31	ON

Press the D key to restore all redundant groups to their default caching parameter, which is “On”. The effect is immediate: it is not necessary to reboot the controller.

Disk Parameters

Use the disk parameters screen to set the termination on a Voyager 5000’s disk channel modules. By default, the controller terminates its end of each SCSI disk channel at the I/O channel module. It is possible, to design a configuration in which the controller is not at the end of one or more disk channels. In this case, you must enter the *Disk Parameters* screen and disable termination for any disk channel modules that do not reside at the end of the SCSI bus.

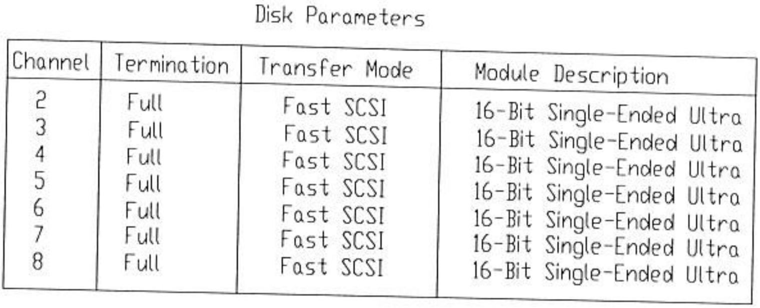
If you have an 8-bit, narrow disk channel, you will have the choice between Full termination and None. Full is the default. Set the channel to None if you wish to disable termination for that module. If you have a 16-bit, wide disk channel you may select from among, Full, Partial, and None. Use partial termination when you wish to terminate only the upper 8 bits of the wide SCSI bus and allow the lower 8 bits to continue to subsequent narrow disk drives and an 8-bit terminator.

To change the termination on a disk channel, use the arrow keys to highlight a channel. Press Enter to edit the termination field. Use the arrow keys to change the termination field's value. Then press enter to complete the change or Ctrl-Z to abort.

Transfer Mode

This field lets you specify the transfer mode on ULTRA disk I/O modules. If needed or desired, you can override the default transfer mode setting for an ULTRA disk module from Ultra SCSI to Fast SCSI. The setting for FAST disk I/O modules is not editable and cannot be changed. Similarly to *Host Parameters* page changes, the system must be restarted for the new transfer mode to take effect.

Figure 5-15. Disk Parameters Screen



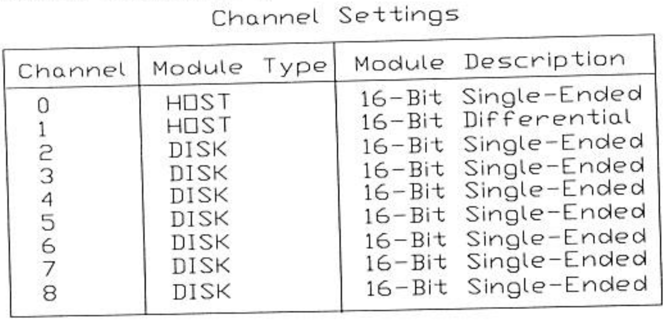
Disk Parameters

Channel	Termination	Transfer Mode	Module Description
2	Full	Fast SCSI	16-Bit Single-Ended Ultra
3	Full	Fast SCSI	16-Bit Single-Ended Ultra
4	Full	Fast SCSI	16-Bit Single-Ended Ultra
5	Full	Fast SCSI	16-Bit Single-Ended Ultra
6	Full	Fast SCSI	16-Bit Single-Ended Ultra
7	Full	Fast SCSI	16-Bit Single-Ended Ultra
8	Full	Fast SCSI	16-Bit Single-Ended Ultra

Channel Settings

The Voyager 5000 permits the I/O modules in slots 1, 2, and 3 to be configured as host or disk channel modules. The *Channel Settings* screen is the place to configure these modules. Use the up and down arrow keys to maneuver to the channel you wish to configure and press Enter. Then use the arrow keys to toggle between host and disk. Press Enter again to save your selection. Channel 0 is always a host channel and channels 4 through 6 are always disk channels, so the monitor utility will restrict access to these fields. An example of the *Channel Settings* screen is shown in Figure 5-16.

Figure 5-16. Channel Settings Screen



Channel Settings

Channel	Module Type	Module Description
0	HOST	16-Bit Single-Ended
1	HOST	16-Bit Differential
2	DISK	16-Bit Single-Ended
3	DISK	16-Bit Single-Ended
4	DISK	16-Bit Single-Ended
5	DISK	16-Bit Single-Ended
6	DISK	16-Bit Single-Ended
7	DISK	16-Bit Single-Ended
8	DISK	16-Bit Single-Ended

NOTE: You must restart the controller when you change the setting of one or more channels. Use the *Restart System* option from the *System Functions* menu.

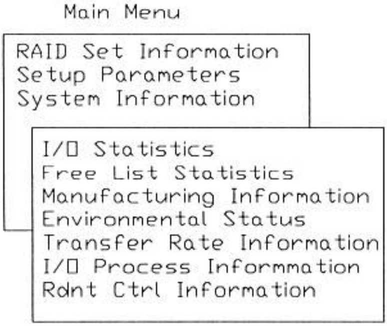
Redundant Controller Parameters

The *Redundant Controller Parameters* screen applies only to configurations with redundant controllers.

System Information

System information offers the following views of your RAID system: *I/O Statistics, Free List Statistics, Manufacturing Information, Environmental Status, Transfer Rate Information, I/O Process Information,* and *Rdnt Ctrlr Information.* The System Information screen is shown in Figure 5-17.

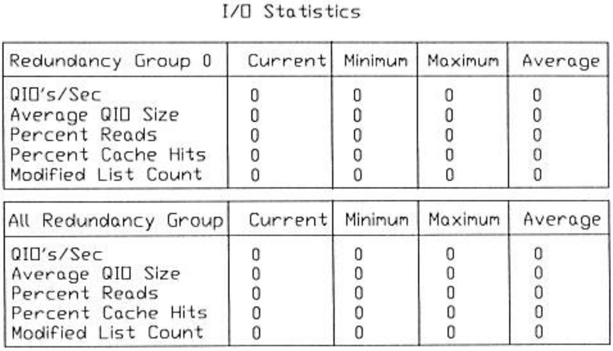
Figure 5-17. **System Information Screen**



I/O Statistics

This screen displays information that can help you determine how efficiently the controller is handling I/O requests. An example of the *I/O Statistics* screen is shown in Figure 5-18.

Figure 5-18. **I/O Statistics Screen**



I/O Statistics

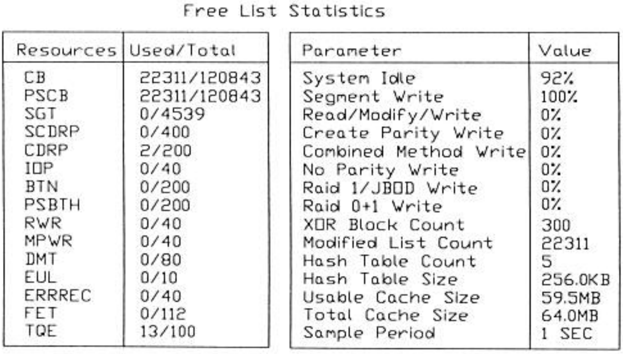
Redundancy Group 0	Current	Minimum	Maximum	Average
QIO's/Sec	0	0	0	0
Average QIO Size	0	0	0	0
Percent Reads	0	0	0	0
Percent Cache Hits	0	0	0	0
Modified List Count	0	0	0	0

All Redundancy Group	Current	Minimum	Maximum	Average
QIO's/Sec	0	0	0	0
Average QIO Size	0	0	0	0
Percent Reads	0	0	0	0
Percent Cache Hits	0	0	0	0
Modified List Count	0	0	0	0

Free List Statistics

This screen shows the status of the controller's internal structures. This screen is intended primarily for use by technical support personnel, but some of the information is useful to know when you are configuring the controller. This is especially true of the *CB Resource* and *Usable Cache Size* values, which enter into the formula for selecting a chunk size. An example of the *Free List Statistics* screen is shown in Figure 5-19.

Figure 5-19. Free List Statistics Screen

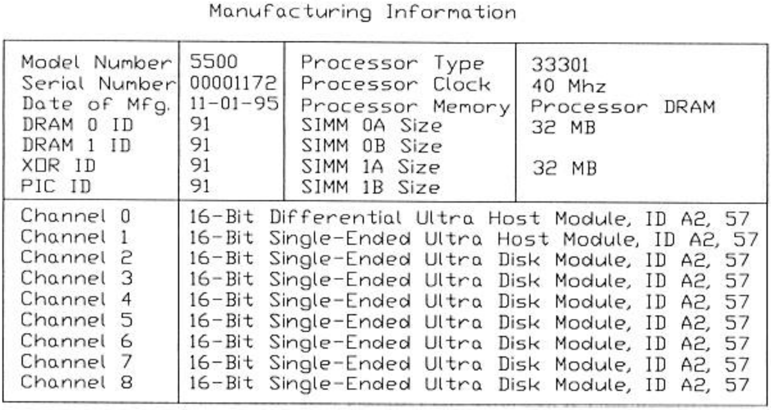


```
                       Free List Statistics

 Resources | Used/Total         Parameter              | Value
 ----------+------------        -----------------------+---------
 CB        | 22311/120843       System Idle            | 92%
 PSCB      | 22311/120843       Segment Write          | 100%
 SGT       | 0/4539             Read/Modify/Write      | 0%
 SCDRP     | 0/400              Create Parity Write    | 0%
 CDRP      | 2/200              Combined Method Write  | 0%
 IOP       | 0/40               No Parity Write        | 0%
 BTN       | 0/200              Raid 1/JBOD Write      | 0%
 PSBTH     | 0/200              Raid 0+1 Write         | 0%
 RWR       | 0/40               XOR Block Count        | 300
 MPWR      | 0/40               Modified List Count    | 22311
 DMT       | 0/80               Hash Table Count       | 5
 EUL       | 0/10               Hash Table Size        | 256.0KB
 ERRREC    | 0/40               Usable Cache Size      | 59.5MB
 FET       | 0/112              Total Cache Size       | 64.0MB
 TQE       | 13/100             Sample Period          | 1 SEC
```

Manufacturing Information

This screen is intended for authorized service technicians, but the user may find it useful for determining how much memory is installed in the cache and what kind of modules are installed in the I/O slots. An example of the *Manufacturing Information* screen is shown in Figure 5-20.

Figure 5-20. Manufacturing Information Screen

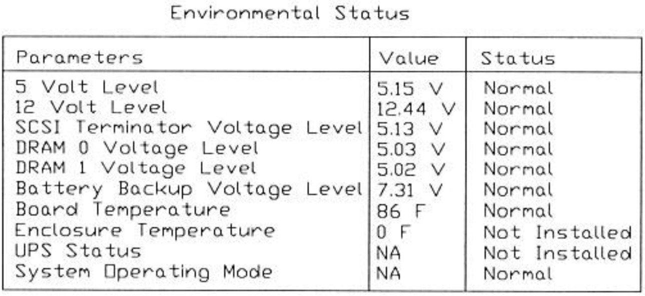


```
                    Manufacturing Information

 Model Number  | 5500     | Processor Type   | 33301
 Serial Number | 00001172 | Processor Clock  | 40 Mhz
 Date of Mfg.  | 11-01-95 | Processor Memory | Processor DRAM
 DRAM 0 ID     | 91       | SIMM 0A Size     | 32 MB
 DRAM 1 ID     | 91       | SIMM 0B Size     |
 XOR ID        | 91       | SIMM 1A Size     | 32 MB
 PIC ID        | 91       | SIMM 1B Size     |
 --------------+----------------------------------------------------------
 Channel 0     | 16-Bit Differential Ultra Host Module, ID A2, 57
 Channel 1     | 16-Bit Single-Ended Ultra Host Module, ID A2, 57
 Channel 2     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 3     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 4     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 5     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 6     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 7     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
 Channel 8     | 16-Bit Single-Ended Ultra Disk Module, ID A2, 57
```

Environmental Status

This screen displays a snapshot of the crucial environmental factors that must be within the normal range for proper operation of the controller. An example of the *Environmental Status* screen is shown in Figure 5-21.

Figure 5-21. Environmental Status Screen



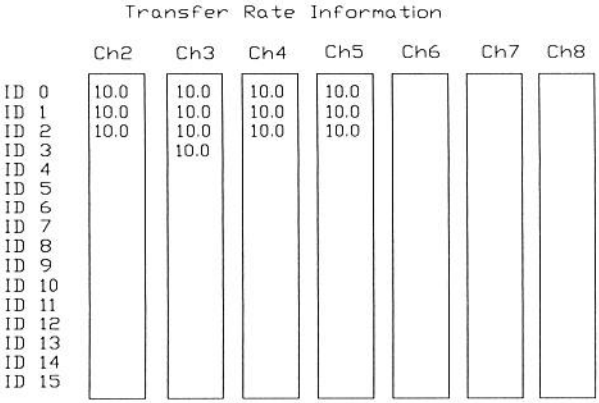
Environmental Status

Parameters	Value	Status
5 Volt Level	5.15 V	Normal
12 Volt Level	12.44 V	Normal
SCSI Terminator Voltage Level	5.13 V	Normal
DRAM 0 Voltage Level	5.03 V	Normal
DRAM 1 Voltage Level	5.02 V	Normal
Battery Backup Voltage Level	7.31 V	Normal
Board Temperature	86 F	Normal
Enclosure Temperature	0 F	Not Installed
UPS Status	NA	Not Installed
System Operating Mode	NA	Normal

Transfer Rate Information

This screen shows the data transfer rate on each SCSI channel the controller is connected to. An example of the *Transfer Rate Information* screen is shown in Figure 5-22.

Figure 5-22. Transfer Rate Information Screen



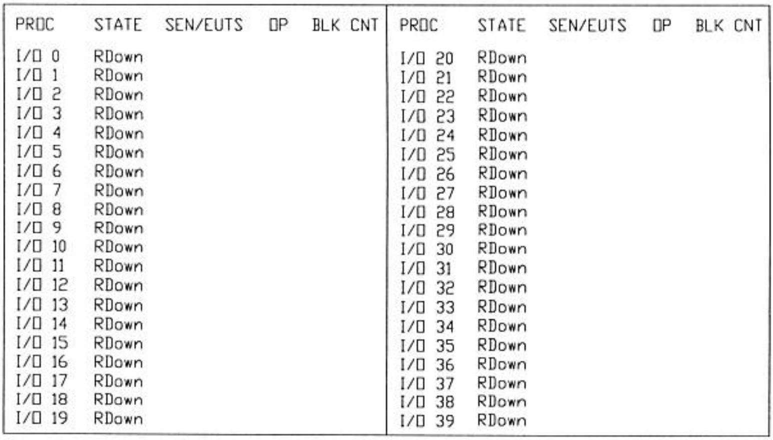
Transfer Rate Information

	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8
ID 0	10.0	10.0	10.0	10.0			
ID 1	10.0	10.0	10.0	10.0			
ID 2	10.0	10.0	10.0	10.0			
ID 3		10.0					
ID 4							
ID 5							
ID 6							
ID 7							
ID 8							
ID 9							
ID 10							
ID 11							
ID 12							
ID 13							
ID 14							
ID 15							

I/O Process Information

This screen is intended for use by authorized service personnel as a troubleshooting tool. It contains no information that the average user will find useful. An example of the *I/O Process Information* screen is shown in Figure 5-23.

Figure 5-23. I/O Process Information Screen



```
PROC    STATE  SEN/EUTS  OP  BLK CNT | PROC    STATE  SEN/EUTS  OP  BLK CNT
I/O 0   RDown                        | I/O 20  RDown
I/O 1   RDown                        | I/O 21  RDown
I/O 2   RDown                        | I/O 22  RDown
I/O 3   RDown                        | I/O 23  RDown
I/O 4   RDown                        | I/O 24  RDown
I/O 5   RDown                        | I/O 25  RDown
I/O 6   RDown                        | I/O 26  RDown
I/O 7   RDown                        | I/O 27  RDown
I/O 8   RDown                        | I/O 28  RDown
I/O 9   RDown                        | I/O 29  RDown
I/O 10  RDown                        | I/O 30  RDown
I/O 11  RDown                        | I/O 31  RDown
I/O 12  RDown                        | I/O 32  RDown
I/O 13  RDown                        | I/O 33  RDown
I/O 14  RDown                        | I/O 34  RDown
I/O 15  RDown                        | I/O 35  RDown
I/O 16  RDown                        | I/O 36  RDown
I/O 17  RDown                        | I/O 37  RDown
I/O 18  RDown                        | I/O 38  RDown
I/O 19  RDown                        | I/O 39  RDown
```

Rdnt Ctrlr Information

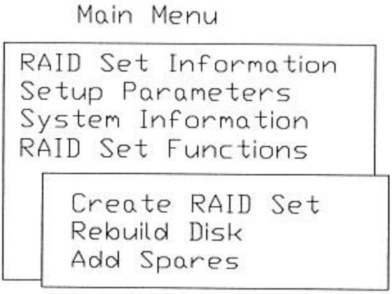
This feature will be discussed later in this manual.

RAID Set Functions

How to Create a RAID Set

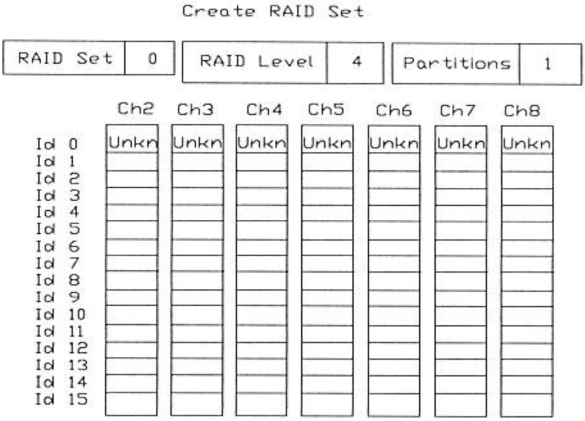
Select the *RAID Set Functions* option from the Main Menu. A screen like that in Figure 5-24 will appear.

Figure 5-24. RAID Set Functions Menu



Select the *Create RAID Set* option from this sub-menu and a screen like that in Figure 5-25 will appear.

Figure 5-25. Create RAID Set Screen


Create RAID Set

RAID Set 0
RAID Level 4
Partitions 1

	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8
Id 0	Unkn	Unkn	Unkn	Unkn	Unkn	Unkn	Unkn
Id 1							
Id 2							
Id 3							
Id 4							
Id 5							
Id 6							
Id 7							
Id 8							
Id 9							
Id 10							
Id 11							
Id 12							
Id 13							
Id 14							
Id 15							

RAID Set

This is the number that the controller will use to identify the RAID set. It is not necessarily the logical unit number (LUN) that your operating system will use to address the RAID set. The LUN is determined by the *Redundant Group* number you assign to a particular RAID set or partition of a RAID set. You may specify a *Redundancy Group* number later in the creation process, or change the number with the *Host LUN Mapping* screen under the *Setup Parameters* screen.

RAID Level

The controller supports RAID levels 0, 1, 0+1, 4 and 5. It also supports JBOD ("Just a Bunch Of Drives").

Drive Selection

The drives connected to the controller are depicted in an array organized by drive channel and SCSI ID. Drives that are not in use and thus available for selection will show up as *Unkn* (Unknown). Drives that already have been assigned to a RAID set will be identified with the RAID set number of which they are a member. To select a drive for inclusion in a RAID Set, use the arrow keys to highlight the field for that drive. Press Enter to edit the field. Then use the arrow keys to spin through the available options. Select *Onli* (On-line) to make a drive an active member of the RAID set, and press Enter to save your selection.

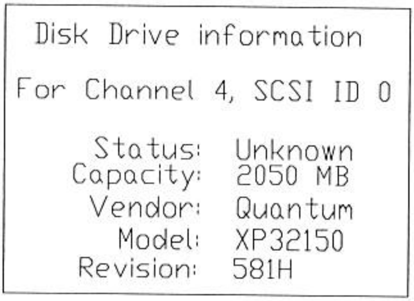
Partitions

This is the number of partitions to be created out of the RAID set. Each partition will have its own Redundancy Group number, which translates into the logical unit number (LUN) that the host will see, unless you map the group to another LUN with the *Host LUN Mapping* screen. You may create up to 16 partitions.

Drive Info

You may select any Channel/ID cell and press "I" to view information about the specified disk drive, such as in the example below. If you select an empty cell, the controller will scan the SCSI bus and identify any disk drives added to the bus since the controller was last booted up. An example of the *Disk Drive Information* screen is shown in Figure 5-26.

Figure 5-26. Disk Drive Information Screen

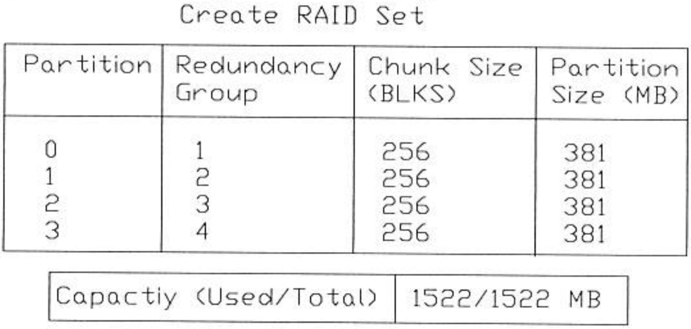


```
  Disk Drive information

For Channel 4, SCSI ID 0

     Status:  Unknown
   Capacity:  2050 MB
     Vendor:  Quantum
      Model:  XP32150
   Revision:  581H
```

NOTE: The width (number of drives) of each partition is equal to the width of the RAID set that encompasses it. All partitions within a RAID set will have the same RAID level. The controller does not support multiple RAID levels within the same RAID set.

After you have selected the drives for your RAID set, press C to continue to the next step of the creation process. The controller will ask you to enter a redundancy group number and chunk size for each partition. By default, the controller will assign a 256-block chunk size to each redundancy group, and equally apportion the available disk space to each redundancy group. If you specified just one partition on the previous screen and you specify less than the full disk capacity in the Partition Size column, the controller will create the redundancy group using only the specified portion of the RAID set. A screen like that in Figure 5-27 below will appear.

Figure 5-27. Selecting Redundancy Groups and Chunk Size



Create RAID Set

Partition	Redundancy Group	Chunk Size (BLKS)	Partition Size (MB)
0	1	256	381
1	2	256	381
2	3	256	381
3	4	256	381

Capactiy (Used/Total)	1522/1522 MB

Redundancy Group Number

The Redundancy Group number will translate to the logical unit number (LUN) that the host will use to address the RAID set. The controller will not let you use a currently assigned Redundancy group.

Chunk Size

RAID systems "Stripe" data when writing to the array. This means that data from the host is broken up into smaller chunks, with each chunk being written to a disk in the array. The size of these chunks (measured in logical blocks) is determined by the Chunk Size parameter. For best results, use the following rules when you are selecting a chunk size:

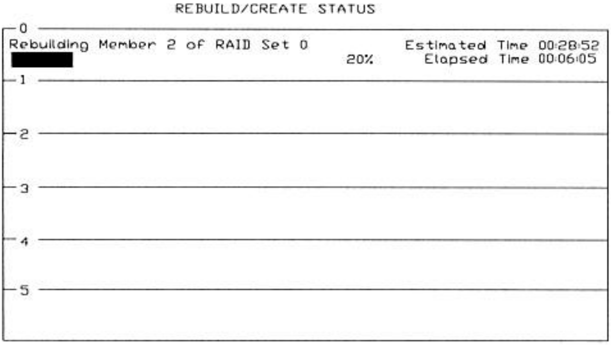
- The chunk size should be a multiple of 32
- The chunk size multiplied by the number of drives in the RAID set (including the parity drive) should be less than half the amount of usable cache. Look on the *Free List Statistics* screen for the amount of usable cache in the controller (see Figure 5-19). This value is expressed in two places on the screen. To get the total usable cache size in blocks, use the value in front of the slash in the CB Resource figure in your calculations.

(ChunkSize X Number_Of_Drives) < (Usable_Cache/2)

Press C again to initiate the creation process. You will be prompted to confirm the action. Press Enter to proceed.

You may view the progress of the RAID set creation by selecting *Rebuild/Create Status* from the Main Menu monitor utility as shown in Figure 5-28.

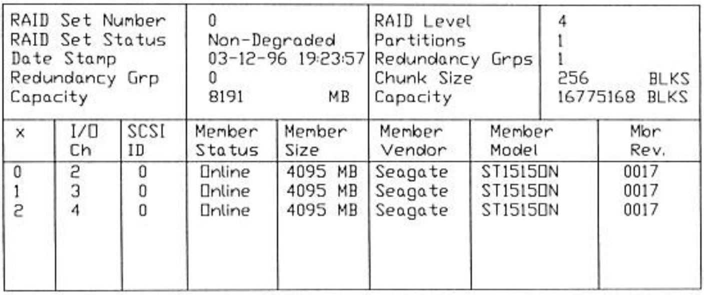
Figure 5-28. Viewing Progress of RAID Set Creation



```
                      REBUILD/CREATE STATUS
 0
Rebuilding Member 2 of RAID Set 0              Estimated Time 00:28:52
████                                  20%        Elapsed Time 00:06:05
 1

 2

 3

 4

 5
```

Once the RAID set has been created it's status can be viewed from the *RAID Set Information* screen as shown in Figure 5-29.

Figure 5-29. Viewing Created RAID Set



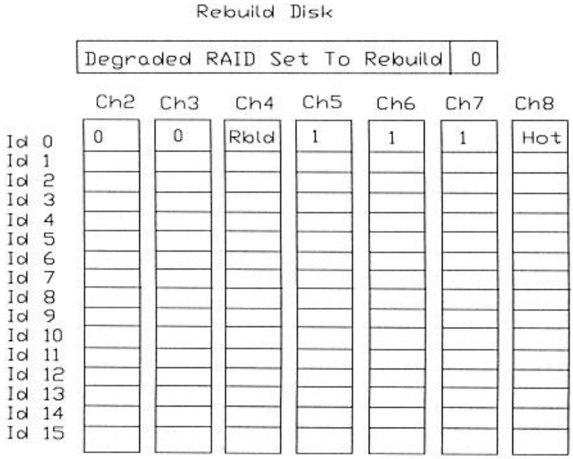
```
RAID Set Number    | 0                 | RAID Level       | 4
RAID Set Status    | Non-Degraded      | Partitions       | 1
Date Stamp         | 03-12-96 19:23:57 | Redundancy Grps  | 1
Redundancy Grp     | 0                 | Chunk Size       | 256       BLKS
Capacity           | 8191          MB  | Capacity         | 16775168  BLKS

 x  | I/O | SCSI | Member | Member  | Member  | Member     | Mbr
    | Ch  | ID   | Status | Size    | Vendor  | Model      | Rev.
 0  | 2   | 0    | Online | 4095 MB | Seagate | ST15150N   | 0017
 1  | 3   | 0    | Online | 4095 MB | Seagate | ST15150N   | 0017
 2  | 4   | 0    | Online | 4095 MB | Seagate | ST15150N   | 0017
```

Rebuild Disk

When a disk drive fails and the controller can not find a suitable spare, you must replace the failed drive and then rebuild the data on the drive. The rebuild operation is initiated from the *Rebuild Disk* screen.

To rebuild a disk, select a degraded RAID set, set the replacement drive to Rbld, and press R to initiate the rebuild process. Press *Enter* to confirm the action. An example of the *Rebuild Disk* screen is shown in Figure 5-30.

Figure 5-30. Rebuild Disk Screen



```
                    Rebuild Disk

       Degraded RAID Set To Rebuild | 0

        Ch2   Ch3   Ch4   Ch5   Ch6   Ch7   Ch8
Id 0    0     0     Rbld  1     1     1     Hot
Id 1
Id 2
Id 3
Id 4
Id 5
Id 6
Id 7
Id 8
Id 9
Id 10
Id 11
Id 12
Id 13
Id 14
Id 15
```

You may connect the replacement drive to any channel and assign any available ID to it. The controller does not require you to insert a new drive in the exact position of the drive it replaces.

NOTE: The size of the replacement drive must be greater than or equal to the smallest drive in the degraded RAID set or the drive it is replacing, whichever is the smaller.

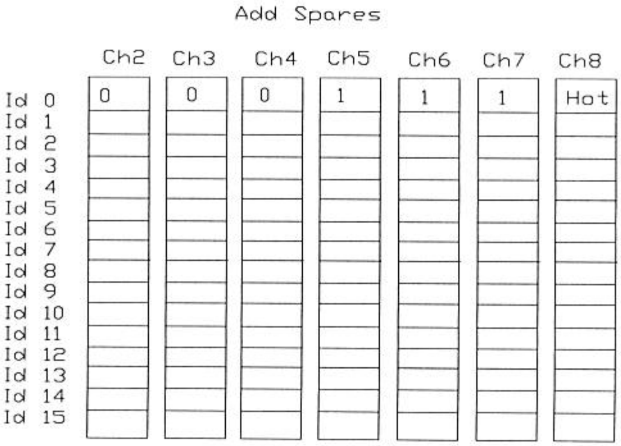
The progress of the rebuild can be monitored by selecting *Rebuild/Create Status* from the Main Menu of the monitor utility.

Add Spare Drive

Use the *Add Spares* screen under the *RAID Set Functions* menu item to designate one or more disk drives as hot or warm spares.

To designate a drive as a spare, use the arrow keys to highlight the field of an available drive and press Enter. A drive identified as *Unkn* is available for designation as a spare. A number in a drive field indicates that the drive is part of a RAID set. Once you have selected a drive field, use the up and down arrow keys to spin through the available options. Stop at *Hot* for a Hot Spare, and *Warm* for a Warm Spare. Press Enter again to save your selection. Finally press *S* to add the specified drives to your pool of spares. An example of the *Add Spares* menu is given in Figure 5-31.

Figure 5-31. Add Spares Screen



Add Spares

	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8
Id 0	0	0	0	1	1	1	Hot
Id 1							
Id 2							
Id 3							
Id 4							
Id 5							
Id 6							
Id 7							
Id 8							
Id 9							
Id 10							
Id 11							
Id 12							
Id 13							
Id 14							
Id 15							

Hot Spare

A hot spare is powered up and spun up at all times to be ready for action at a moments notice. Since a hot spare is always spinning, it is subject to almost as much wear and tear as an active drive.

Warm Spare

A warm spare is powered up at all times, but the controller will spin up the drive only when it is needed to replace a failed drive. This slows the spares response to a drive failure, but it reduces the chance that the spare will fail before it is called into action.

NOTE: Hot and warm spares on the Voyager 5000 are global. They are not assigned to a specific RAID set.

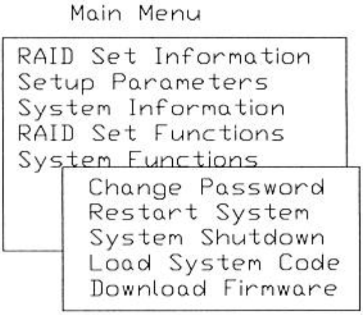
When the controller detects a drive failure, it scans the first drive channel from ID 0 to 6, then the next channel from ID 0 to 6, and so on, until it finds a spare that is large enough to serve in the degraded RAID set. If it finds one, it automatically initiates a rebuild on the spare. If you want hot spares to take precedents over warm spares, be sure to put them on lower channels and IDs than warm spares.

To intentionally degrade a working RAID set, select the drive you want to drop from the RAID set and change it's status to Unknown. Press Enter to save the change, and press M to carry out the modification. The RAID set will immediately become degraded. Once you have replaced or serviced the disk drive, you will have to go to the *Rebuild Disk* screen to restore the RAID set to it's previous status. Once you have entered your changes, press *S* to add the spares.

System Functions

This opens a menu with options for you to change your password, load and save the controller configuration, load new system code, restart the system, and shut down the controller. The *System Functions* menu is shown in Figure 5-32.

Figure 5-32. System Functions Menu



Change Password

The Voyager 5000 offers password protection to prevent unauthorized users from accessing sensitive portions of the monitor utility. The password may be from one to nine characters long and contain any combination of case-sensitive alphanumeric characters. To enable password protection, select *System Parameters* from the *Setup Parameters* menu.

NOTE: The default password is Viper (uppercase V)

To change the password, select *Change Password* from the *System Functions* menu and follow the prompts. The controller will first ask you for the current password. If this is your first attempt at changing the password then enter the default password, Viper. Next, enter the new password. Finally, the controller will ask you to confirm the new password by re-entering it.

If you Forget Your Password

If you forget your password, enter ***lostpassword*** (no space) at the password prompt. The controller will display an access code. Your reseller will be able to use these characters to generate another code that will reset the controller's password to its default setting.

Load System Code

The *Load System Code* option makes it possible to load the most recent firmware version into the controller's EPROM. (The version number of the current firmware is displayed in the title box of the monitor utility's opening screen.)

Eurologic makes the latest version of the Voyager 5000 firmware available on its BBS. Set your communications software to 8 data bits, 1 stop bit, and 0 parity. The primary BBS line is +353-1-2959487.

To begin a code transfer, select *Load System Code* from the *System Functions Menu* and follow the prompts. When the controller informs you that it is ready to load the system code, take whatever steps are necessary to initiate an ASCII file transfer from your communications program. Specify the text file containing the firmware code for the transfer.

NOTE: If you are using a DOS or Windows communications application, you must instruct the application to end each text line with a carriage return/line feed. For instance, if you are using the Terminal application in Windows, you would select Transfers, Select Text File and check the Append LF check box.

If the loading of system files fails for any reason, the controller will inform you of the failure and offer to retry the load. Since the loading process erases the old code in the EPROM, the controller will not operate until you have succeeded in loading new code.

It is also possible to load code during the start-up sequence of the Voyager 5000. Interrupt the loading sequence by pressing CTRL-C after the system has powered up as shown in Figure 5-33. It is advisable to set the baud rate to a higher value to facilitate the code loading speed.

Figure 5-33. Loading System Code During the Power Up Sequence

```
        FLASH Boot Utility Version C0

FBOOT-I-LOAD, Load sequence commencing - Type CTRL/C to abort
FBOOT-I-LOADING, Loading system rev C0 code to 0x00020000:0x80089ef0
FBOOT-F-ABORT, Operation aborted due to CTRL/C

FLASH Boot Utility Options

        1) Download new Firmware Image
        2) Change serial baud rate
        9) Restart Controller
Option:█
```

NOTE: Before upgrading the Firmware it is necessary to remove all batteries and fuses from the controller (see Chapter 8).

Restart System

The *Restart System* option re-initializes the controller, loading and Host parameter changes in the process.

NOTE: When you change the controller's host parameters, you must restart the system to initialize the new values. Any changes you make will not take effect until you perform a restart.

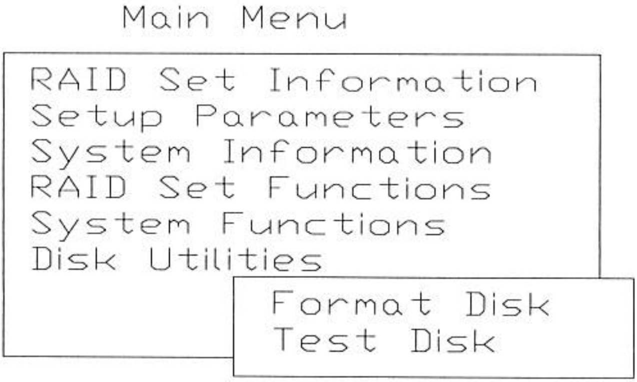
System Shutdown

If you should need to power down the controller, select *System Shutdown* prior to shutting off the power. This will cause the controller to immediately flush its cache and proceed with a graceful shutdown.

Disk Utilities

The controller allows the user to format disk drives through the monitor utility. Up to 20 drives can be formatted at a time. The block size of the drives being formatted will be set automatically to the block size used by the controller. The *Disk Utilities* sub-menu is shown in Figure 5-34.

Figure 5-34. Disk Utilities Menu



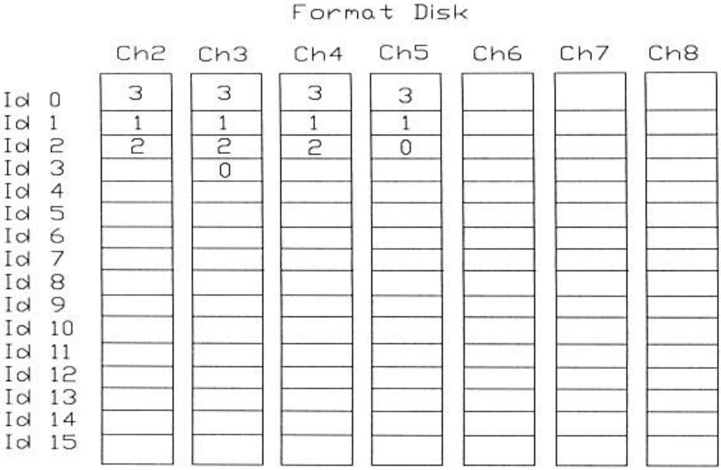
Format Disk

The *Format Disk* screen allows the user to format one or more disks inside the RAID sets. To perform this function:

1. Use the arrow keys to place the cursor on the disk to be formatted.
2. Press Enter to select the disk.
3. Use the up and down arrow keys to select FRMT.
4. Repeat above steps to select other disks to be formatted.
5. When selection is complete, press Enter and F to start the format process.

The *Format Disk* screen is shown in Figure 5-35.

Figure 5-35. Format Disk Screen



Format Disk

	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8
Id 0	3	3	3	3			
Id 1	1	1	1	1			
Id 2	2	2	2	0			
Id 3		0					
Id 4							
Id 5							
Id 6							
Id 7							
Id 8							
Id 9							
Id 10							
Id 11							
Id 12							
Id 13							
Id 14							
Id 15							

NOTE: In redundant controller configurations, all formats initiated by a failing controller will be restarted by the surviving controller after the failover is complete.

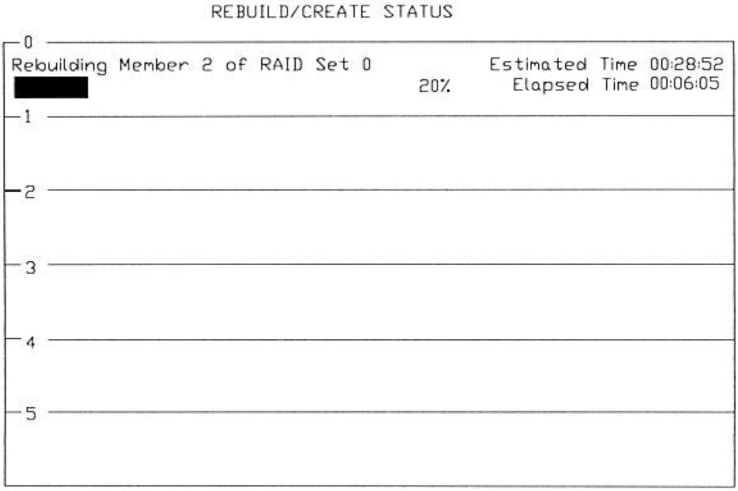
Test Disk

This option is not currently supported by this firmware.

Rebuild/Create Status

This screen provides a continuously updated view of the progress of the rebuild and create operations. An example of the *Rebuild/Create Status* screen is shown in Figure 5-36.

Figure 5-36. Rebuild Create Screen



```
                    REBUILD/CREATE STATUS
 0
Rebuilding Member 2 of RAID Set 0              Estimated Time 00:28:52
                                          20%     Elapsed Time 00:06:05
 1
 2
 3
 4
 5
```

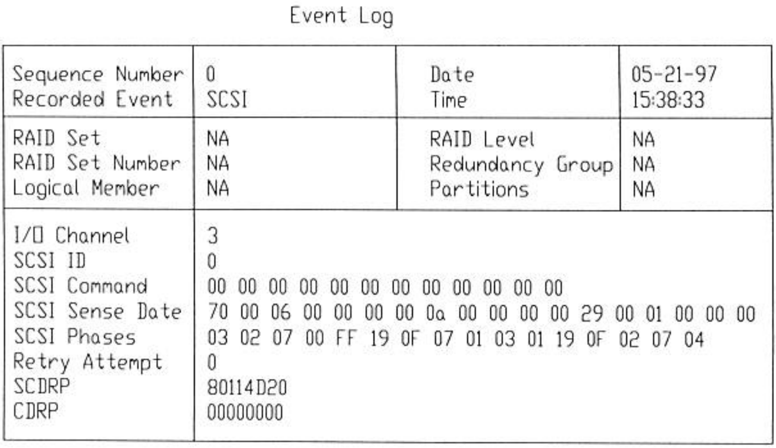
Event Log

The Voyager 5000 controller maintains a running log of controller-related events. These events include the initiation and completion of RAID set creations and rebuilds, drive failures, and SCSI messages emanating from the host and drive channels, among other events. Technical support personnel will find the event log useful in diagnosing problems with the controller.

NOTE: Event log data is stored in a portion of the controllers cache memory. If you have backed up the controller with an external battery or UPS, the event log will persist in memory, even if the controller is powered off or restarted.

To view the event log, select *Event Log* from the main menu. The first event in the log will be displayed. An example of a SCSI event is shown in Figure 5-37.

Figure 5-37. Event Log Screen

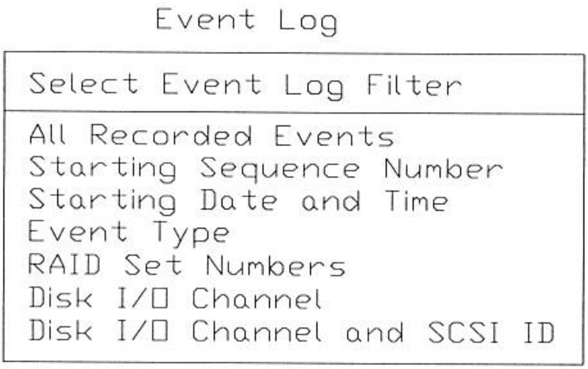


Event Log

Sequence Number	0	Date	05-21-97
Recorded Event	SCSI	Time	15:38:33
RAID Set	NA	RAID Level	NA
RAID Set Number	NA	Redundancy Group	NA
Logical Member	NA	Partitions	NA
I/O Channel	3		
SCSI ID	0		
SCSI Command	00 00 00 00 00 00 00 00 00 00 00 00		
SCSI Sense Date	70 00 06 00 00 00 00 0a 00 00 00 00 29 00 01 00 00 00		
SCSI Phases	03 02 07 00 FF 19 0F 07 01 03 01 19 0F 02 07 04		
Retry Attempt	0		
SCDRP	80114D20		
CDRP	00000000		

You may use the arrow keys to scroll forward and backward through the event log, or "C" to clear the log. If you want to view selected events, press "F" to filter the display. You will be presented with a menu of filters for extracting the events that interest you. Once you select a filter, you may scroll through the resulting display with the up and down arrow keys. The Event Log *Filter* menu is shown in Figure 5-38.

Figure 5-38. Selecting Event Log Filters



Event Log

Select Event Log Filter

All Recorded Events
Starting Sequence Number
Starting Date and Time
Event Type
RAID Set Numbers
Disk I/O Channel
Disk I/O Channel and SCSI ID

All Recorded Events

This option restores the unfiltered view of events. The controller will display the next event log based on the last directional key pressed. If no directional key was pressed, the last event will be displayed.

Starting Sequence Number

If you select this filter, you will be prompted for a starting sequence number. If the controller finds an event with the specified sequence number, it will display the description for that event. You may use the arrow keys to scroll forward or back through the sequence of events.

Starting Date and Time

All events are stamped with the time and date of their occurrence. By selecting this filter, you can jump to the first event that meets the date and time criteria you specify. Once the initial event is displayed, you may use the arrow keys to scroll forward and backward through the remaining events.

Event Type

This filter permits you to specify the type of event you wish to see, to the exclusion of all others. Table 5-1 lists the types of events you may select in the filter prompt.

Table 5-1 Event Types

Event Type	Description
Unknown	Returns any events that the controller could not classify.
Reassigned Block	The controller records a reassigned block event whenever a SCSI reassign block command is issued.
Host	The controller logs a host event whenever it cannot respond to a SCSI command from the host with good status.
Validation Conflict	If the controller detects a problem with a RAID set (such as a drive showing up as a member of more than one RAID set) during its power up routine, it logs a validation conflict.
Drive	This event is reserved for future use in a subsequent environment
Fan	This event is reserved for future use in a subsequent environment

Table 5-1 Event Types

Event Type	Description
Temperature	This event is reserved for future use in a subsequent environment
Dropped Drive	Whenever a disk drive drops out of a RAID set either due to a failure or an action by the operator, the controller will record a dropped drive event.
Rebuild Done	The conclusion of a rebuild operation.
Create Done	The completion of a RAID creation.
Rebuild Initiated	The start of a rebuild.
Create Initiated	The start of a RAID set creation.
Parity	Occurs whenever the controller detects a parity error on the controller's SCSI buses or internal bus.
Port	This event refers to an error that the Voyager 5000's port driver detected while attempting to communicate with disk drives. A drive staying on the SCSI bus too long, or a drive disconnecting from the bus when it isn't supposed to are examples of port events.
SCSI	These events are reported by the disk drives connected to the controller. Refer to the SCSI specification for an explanation of the data displayed in these event logs.
Forced Error Written	Occurs whenever the controller issues a SCSI write long command.
Add Spare Started	Occurs when a drive has been picked as a spare and has passed all of its preliminary checks.
Add Spare Completed	The completion of an add spare operation.
System Power Up	Records the date and time every time the controller is powered up or restarted.
System Shutdown	Records the time and reason of a system shutdown.
IES	Occurs whenever the controller detects a change in its internal environment.
Host Sync Negotiation	Occurs whenever the host performs a SCSI synchronous negotiation with the controller's host process.
Port Sync Negotiation	Occurs whenever the controllers port driver successfully completes a SCSI synchronous negotiation with a disk drive.
Host Wide DMA Negotiation	Occurs when the host performs a SCSI wide DMA negotiation with the controller's SCSI host process.
Port Wide DMA Negotiation	Occurs when the controllers port driver successfully completes a SCSI wide DMA negotiation.

Table 5-1 Event Types

Event Type	Description
Unexpected Port Interrupt	Occurs whenever the port process services an unexpected SCSI chip interrupt
Message Transmitted	Occurs when a message has been transmitted to the other controller in a redundant configuration.
Message Received	Occurs when a message has been received to the other controllers in a redundant configuration.
Redundant Controller Status Change	Occur whenever a change in the status of the redundant controller configuration is detected.
Redundant Controller Parity Error	This event is recorded whenever a parity error is encountered in a redundant controller configuration.
Redundant Controller Parity Error Action	This event is recorded whenever any action is taken to deal with a parity error in a redundant controller configuration.
Format Started	The start of a format operation.
Format Completed	The conclusion of a format operation.

RAID Set Number

Use this filter to view event related to a specified RAID set number.

Disk I/O Channel

Use this filter to view events related to a specific disk I/O channel.

Disk I/O Channel and SCSI ID

Use this filter to view events related to a specific device, identified by its I/O channel and SCSI ID.

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Chapter 6: High Availability Configurations

Introduction

Two controllers may be combined to form a fault-tolerant system. If either controller detects that the other controller is not functioning properly, it automatically assumes responsibility for all system I/O activity. This switch-over occurs automatically and virtually instantly. If you have two controllers equipped with multiple host channels, you may designate individual host channels as either active or passive, providing a means to balance I/O activity between controllers.

Requirements

To combine two controllers as a redundant pair, both controllers must be configured as follows:

1. Both controllers must be equipped with the 5552 motherboard. Controllers with the 5552 motherboard will have a serial number of 5000 or higher.
2. Both controllers must be running the same firmware revision (B.0 or higher).
3. The amount of cache installed in each controller must be the same.
4. The amount of cache installed in SIMM slots 0A and 1A must equal the amount installed in slots 0B and 1B.
5. The same number of SCSI I/O modules must be installed in each controller.
6. The type of I/O module installed in each slot on one controller must be the same as that installed in the corresponding slot on the other controller.
7. Each disk must be connected to the same disk channel on each unit.
8. Corresponding host modules on each controller must also be connected on the same SCSI host busses.
9. The Redundant Controller Communication (RCC) cable must be connected between the two controllers.
10. Each controller must have its own dedicated monitor.

11. Each controller should have a battery connected to it. At least one of the controllers **must** have a battery connected to it, to protect the cache data in the event of a power failure.

NOTE: To avoid conflict between controllers in a High Availability configuration, set a validation delay of 30 seconds on one controller. The other controller has a delay of 0 seconds set on it. This means that the second controller waits 30 seconds before starting to poll the drives. The first controller has already polled the drives, so there is no conflict. To set the delay use the *Setup Parameters* screen from the Main Menu of the monitor utility.

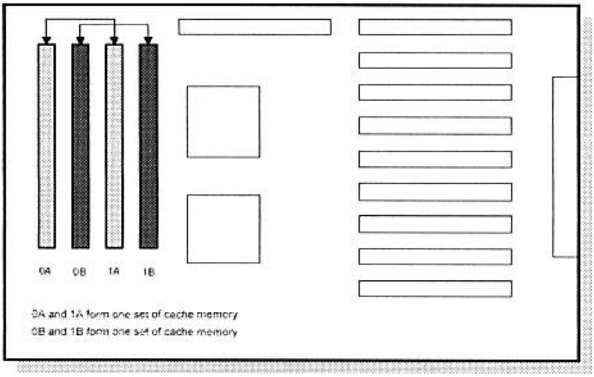
SIMM Installation

To utilize the redundant controller capability of a pair of Controllers, both units must have the same amount of SIMM cache installed.

WARNING: Be sure to remove all power (including battery power) to the controller before installing SIMMs. Observe all anti-ESD practices before you touch a SIMM.

On the 5552 motherboard, slots 0A and 1A form one set of cache memory. Slots 0B and 1B form another set. While one set is reading and writing data, the other set is "mirroring" the read/write. In the event of one controller's failure, one of the two halves of cache memory in the surviving controller takes over the failed unit's read/write functions. Refer to Figure 6-1.

Figure 6-1. Cache Layout with Voyager High Availability Systems


0A
0B
1A
1B
0A and 1A form one set of cache memory
0B and 1B form one set of cache memory

NOTE: It is not necessary for the SIMM configuration to be congruent as long as the same amount of memory is installed in each pair. For example: if a 64MB SIMM is in slot 0A, a 32MB SIMM is in slot 0B and a 32MB SIMM is in slot 1B, the requirements are met even though slot 1A is empty.

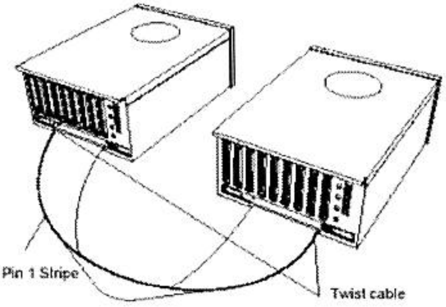
Eurologic recommends that SIMMs from the same manufacturer be used in any one controller. If you are installing only one SIMM in a slot pair, use slot 0A or slot 0B as appropriate.

RCC Cable Connection

WARNING: Do NOT force the RCC cable connectors into the redundant controller connectors. Serious damage may result.

To function in the redundant controller mode, the two identically configured controllers must be connected together with the specially provided redundant controller communication (RCC) cable. The cable must be twisted so that pin 1 on one controller matches pin 50 on the other controller, as shown in Figure 6-2.

Figure 6-2. RCC Cable Orientation

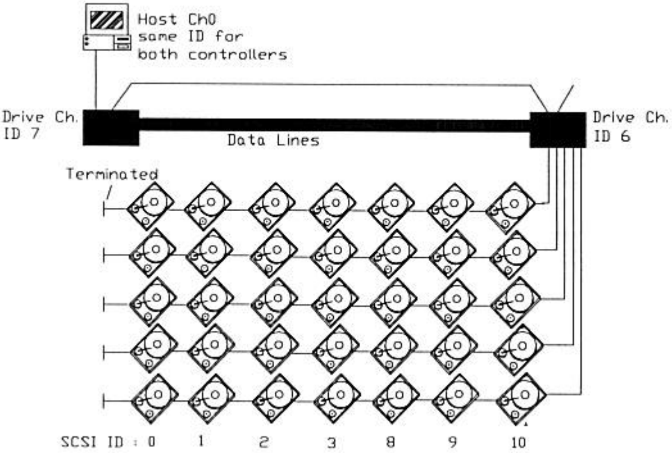


Single-Host Configuration Examples

Single-Host Active/Active Configuration[1]

Figure 6-3 depicts one typical redundant controller with two host channels per controller and a single host.

Figure 6-3. Single Host Active/Active Example Configuration



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[1] In high availability configurations a special cable kit is used to setup the Host connection. Due to the cable length involved, all Host connections should be made using differential SCSI.

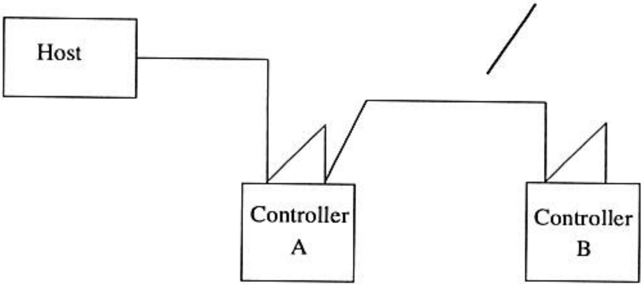
The disk drives are strung on disk channels by each controller. By designating one host channel on each controller as active, the resources of both controllers may be used to manage I/O activity, whilst maintaining redundancy. Table 6-1 lists host channels, SCSI IDs and status for a typical single-host configuration.

Table 6-1 Single Host Configuration Channel Designations

Controller/Host Channel	SCSI ID	Status
A/0	0	Active
A/1	1	Passive
B/0	0	Passive
B/1	1	Active

By using *Host LUN Mapping*, I/O traffic may be balanced between controllers by assigning some of the redundant groups to one host channel and the remainder to the other host channel. In the above example, redundancy groups mapped to host channel 0 would be handled by controller A. Groups mapped to host channel 1 would be handled by controller B.

Cabling the Single Host Active/Active Configuration

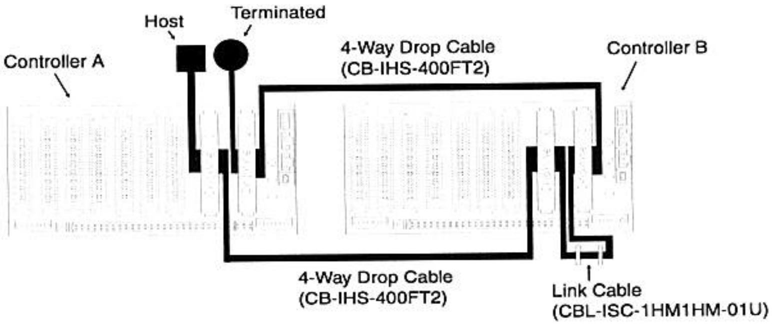


- Insert one end of the first 4-way drop off cable (CB-IHS-400FT2) into the back of the Voyager 5000 controller shelf.
- The first 68-way drop off connector is connected to Host Channel 0 on con-

troller A.

- The next 68-way drop off connector is connected to Host Channel 0 on controller B.
- The end connector is inserted into the back panel of the Voyager 5000 controller shelf.
- Insert one end of the second 4-way drop off cable (CB-IHS-400FT2) into the back panel of the Voyager 5000 controller shelf.
- The first 68-way drop off connector is connected to Host Channel 1 on controller B.
- The next 68-way drop off connector is connected to Host Channel 1 on controller A.
- The end connector is inserted into the back panel of the Voyager 5000 controller shelf.
- Attach the link cable (CB-ISC-1HM1HM-01U) between both 4-way drop off cables.
- Connect the terminator provided to one of the remaining 2 68-way connectors on the Voyager 5000 back panel.

The cabling for this configuration is shown below.



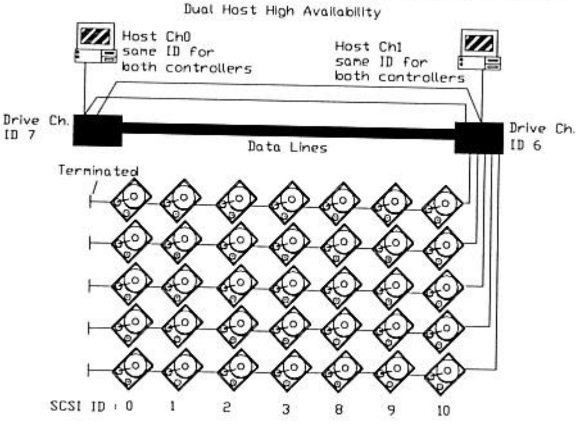
Single Host Active/Passive Configuration

It is also possible to use only one host channel per controller. One controller will still back up the other, but the passive controller will engage in no I/O activity until it detects that the other controller has stopped responding.

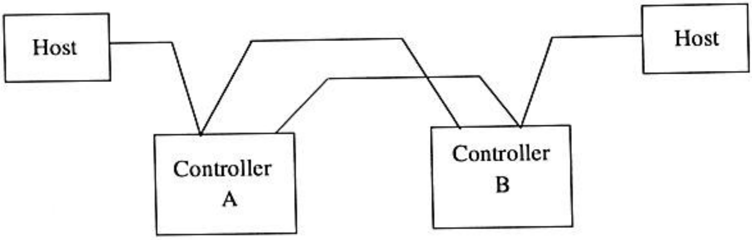
Multiple Host Configuration

In the example shown in Figure 6-4 both controllers have two host channels. Host computer 0 is connected to host channel 0 on both controllers and host computer 1 is connected to host channel 1 on both controllers.

Figure 6-4. Dual Host Active/Active Example Configuration

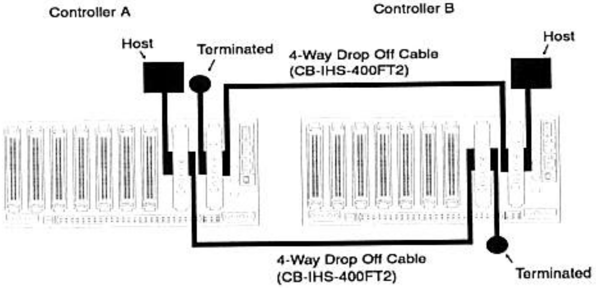


Cabling the Dual Host Active/Active Configuration

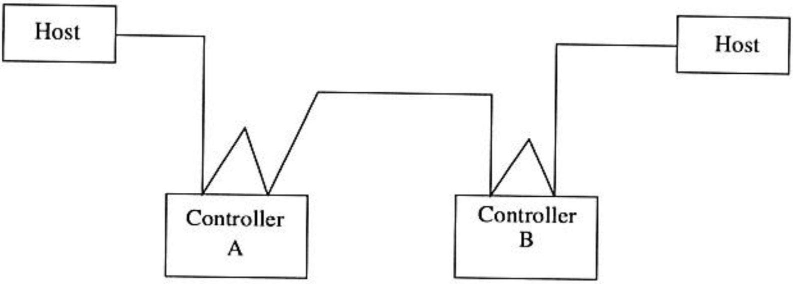


- Insert one end of the first 4-way drop off cable (CB-IHS-400FT2) into the back panel of the Voyager 5000 controller shelf.
- The first 68-way drop off connector is connected to Host Channel 0 on controller A.
- The next 68-way drop off connector is connected to Host Channel 0 on controller B.
- The end connector is inserted into the Voyager 5000 controller shelf.
- Insert one end of the second 4-way drop off cable (CB-IHS-400FT2) into the Voyager 5000 controller shelf.
- Connect one of the terminators provided, to one of the two connectors for the first 4-way drop off cable, and the second terminator to one of the connectors for the second 4-way drop off cable on the Voyager 5000 controller shelf.

The cabling for this configuration is shown below.

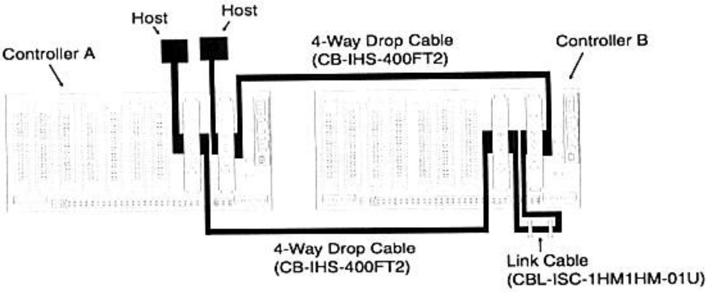


Cabling the Dual Port/Dual Host Active/Active Configuration



- Insert one end of the first 4-way drop off cable (CB-IHS-400FT2) into the back panel of the Voyager 5000 controller shelf.
- The first 68-way drop off connector is connected to Host Channel 0 on controller A.
- The next 68-way drop off connector is connected to Host Channel 0 on controller B.
- The end connector is inserted into the backpanel of the Voyager 5000 controller shelf.
- Insert one end of the second 4-way drop off cable (CB-IHS-400FT2) into the back panel of the Voyager 5000 controller shelf.
- The first 68-way drop off connector is connected to Host Channel 1 on controller B.
- The next 68-way drop off connector is connected to Host Channel 1 on controller A.
- The end connector is inserted into the back panel of the Voyager 5000 controller shelf.
- Attach the link cable (CB-1HM1HM-01U) between both 4-way drop off cables.

The cabling for this configuration is shown below.

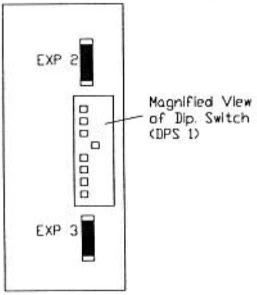


Setting the SCSI ID on Fault Tolerant Voyager 5000

This section refers to the configuration of the SCSI target bus IDs on the backplane of Voyager 5000 Fault Tolerant solutions. For information relating to setting up the host ID refer to Chapters 5 & 6. The backplane within the disk shelves can be configured as a single SCSI bus or may be split into two SCSI buses. A Voyager 5003 is configured as three shelves with each shelf split into two buses. Voyager 5005 and 5006 models are configured as single SCSI bus shelves.

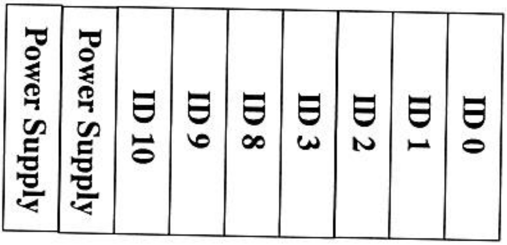
There is an eight position switch (DPS1) mounted on the backplane and it is used to set the SCSI IDs of both target buses. The switches which are accessible from the rear of the units set the base SCSI IDs for each bus. Figure 6-5 shows the location of the switch on the backplane.

Figure 6-5. Location of DPS1 on Backplane



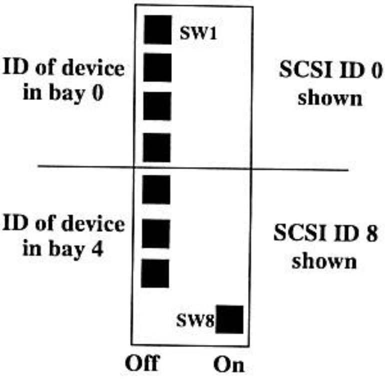
Switch positions 1 - 4 are used to set the starting ID for the first device (Bay 0) on the bus. Devices in bays 1, 2 and 3 will automatically increment this ID by one in turn[2]. For example if the device in bay 0 is set to be at SCSI ID 0 then the device in bay 1 will automatically appear as ID 1, the device in bay 2 will appear as ID 2 and the device in bay 3 will appear as ID 3. Where a backplane is configured as a single bus the device will occupy SCSI IDs 0, 1, 2, 3, 8, 9, 10 where the device at ID 0 is at the right hand side of the rack as shown in Figure 6-6.

Figure 6-6. SCSI ID allocation in single bus shelf



The default setting of the switchpack - DPS1 for a shelf configured as a single SCSI bus is shown in Figure 6-7.

Figure 6-7. Default Switch Settings for a Single SCSI Bus



---

[2] If the starting address is at 15 then the subsequent IDs will *roll over* so that the second drive will take SCSI ID 0, the third drive ID 1 etc.

In the case of a shelf split into two buses (which is standard in the VRA-5003) the IDs are set at 0 - 3 in the first section and 0 - 2 in the second section as shown in Figure 6-8.

Figure 6-8. SCSI ID Allocation in a Dual Bus Shelf

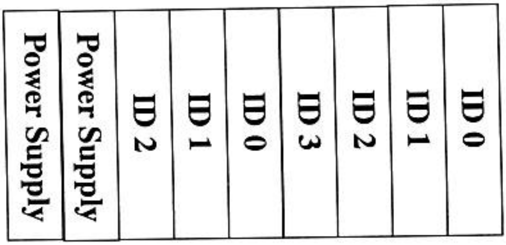
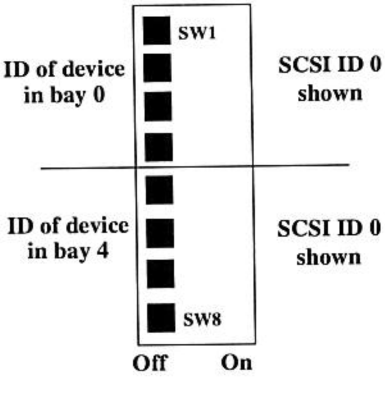


Figure 6-9 shows the default switch settings for a shelf configured as a dual SCSI bus.

Figure 6-9. Default switch setting for a dual SCSI bus configuration



SW-1 of DPS1 corresponds to the L.S.B. of the ID of the device in bay 0, whilst SW-4 corresponds to the M.S.B. of the ID of the device in bay 0. SW-5 of DPS1 corresponds to the L.S.B. of the device in bay 4, whilst SW-8 corresponds to the M.S.B. of the ID of the device in bay 4. As there are four switches the switch positions are arranged to allow 16 possible IDs from 0 - 15.

NOTE: It will not normally be necessary to alter these SCSI IDs from their factory settings.

Configuring Redundant Controller Operation

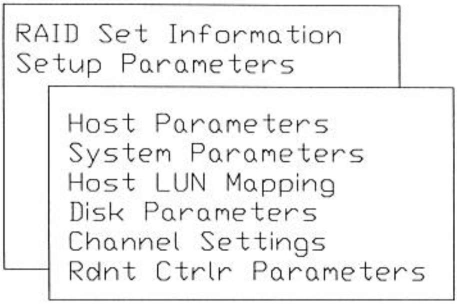
Setting Node Names and Active/Passive Designations

There are two serial ports accessible from the rear of the cabinet which are clearly labeled, each controller requires that it is set separately as described in the following paragraphs.

After setting the hardware up as described above, the two controllers can be powered on. After running the self test, they will automatically attempt to bind themselves into a redundant controller set.

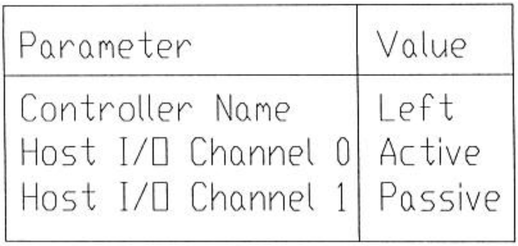
Go to the Main Menu and select *Setup Parameters.*

Figure 6-10. Setting Redundant Controller Parameters



Select *Rdnt Ctrlr Parameters*. The following screen will appear.

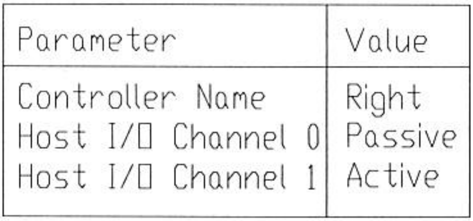
Figure 6-11. Designating Channels as Active or Passive on the 1st Controller



Parameter	Value
Controller Name	Left
Host I/O Channel 0	Active
Host I/O Channel 1	Passive

In the example shown in Figure 6-11 the first controller has been given the node name "Left" and the first host channel is configured to be active with the second host channel configured to be passive. Figure 6-12 shows the settings for the second controller "Right" with the active/passive designations reserved.

Figure 6-12. Designating Channels as Active or Passive on the 2nd Controller



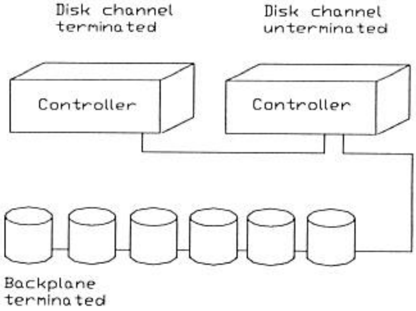
Parameter	Value
Controller Name	Right
Host I/O Channel 0	Passive
Host I/O Channel 1	Active

With this setup the normal operation will be that the first controller "Left" will access the disks through Host Channel 0 and the second controller "Right" will access the disks through Host Channel 1. To change any of the settings, position the cursor over the relevant field and press Enter to edit the field.

Setting Disk Parameters

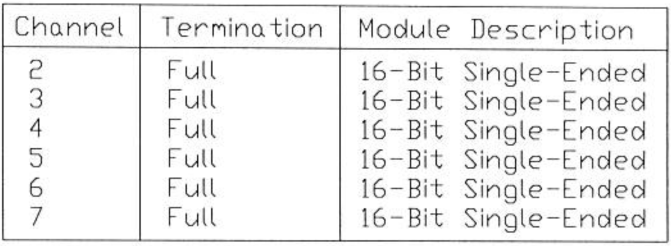
The diagram shown in Figure 6-3 and Figure 6-4 represent a *logical* view of the cabling. Figure 6-13 shows a physical view. Voyager 5000 models are cabled by starting at the first controller, daisy chaining to the second controller and then looping to the disks. This is to adhere to SCSI cable length restrictions. Termination is set on the first controller and will end up terminated at the far end of the disk chain. This requires that termination is set up on the first controller only and the second controller will be un-terminated.

Figure 6-13. Physical Cabling for High Availability Configurations



To verify or alter these settings, select *Setup Parameters/Disk Parameters* and set the disk channel termination parameters to be ON for the first controller and OFF for the second controller. Figure 6-14 shows the configuration menu settings for the first controller.

Figure 6-14. Setting the Disk Termination Parameters



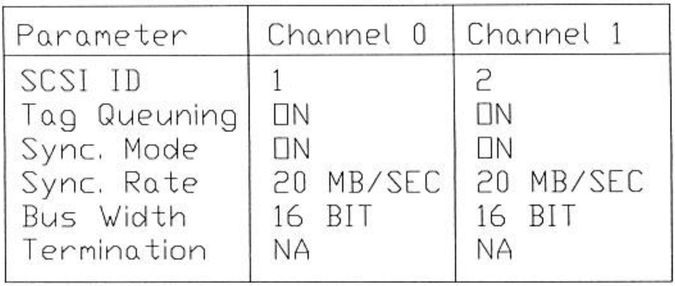
Channel	Termination	Module Description
2	Full	16-Bit Single-Ended
3	Full	16-Bit Single-Ended
4	Full	16-Bit Single-Ended
5	Full	16-Bit Single-Ended
6	Full	16-Bit Single-Ended
7	Full	16-Bit Single-Ended

Setting Host Parameters

Configure each active host module as required. Each host channel configuration must complement its counterpart on the other controller. When two controllers boot up and attempt to form a redundant pair, the first controller to boot up will identify its active host channels and instruct the other controller to configure its counterpart host channels to match those on the first. Similarly, when the second controller boots up, it will copy the configuration information for its active host channels to the other controller.

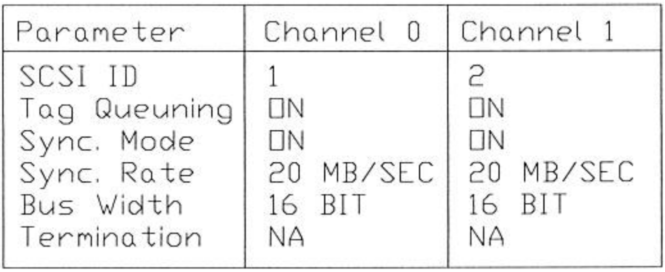
Figure 6-15 shows one possible arrangement for a controller with two host channels and Figure 6-16 shows how the other controller is set up.

Figure 6-15. Host Settings for the First Controller



Parameter	Channel 0	Channel 1
SCSI ID	1	2
Tag Queuning	ON	ON
Sync. Mode	ON	ON
Sync. Rate	20 MB/SEC	20 MB/SEC
Bus Width	16 BIT	16 BIT
Termination	NA	NA

Figure 6-16. Host Settings for the Second Controller



Parameter	Channel 0	Channel 1
SCSI ID	1	2
Tag Queuning	ON	ON
Sync. Mode	ON	ON
Sync. Rate	20 MB/SEC	20 MB/SEC
Bus Width	16 BIT	16 BIT
Termination	NA	NA

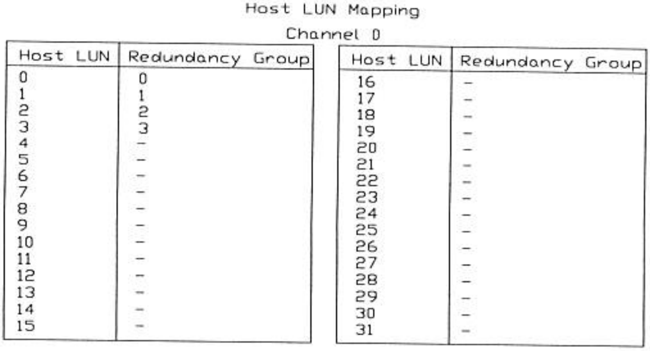
When finished, press CTRL-Z to return to the Main Menu.

Host LUN Mapping

If you have more than one host channel in each controller, you may balance I/O activity between each controller with the *Host LUN Mapping* screen. Enter the *Setup Parameters/Host LUN Mapping* screen from the Main Menu and select an active host channel with the N and P keys. (The controller will not let you set LUN mapping for a passive channel). Use the C key to clear the screen if you want to start with a blank slate. Then, match the redundancy groups that you wish this host channel to handle, to a logical unit number (LUN). This is the LUN that the host will use to address the redundancy group. A dash(-) indicates that the LUN is not mapped to any redundancy group.

When you have finished with one active host channel, switch to the other controller's Host LUN Mapping screen, select an active host channel, and assign LUNs to other redundancy groups not mapped to the controller's active host channel or channels. For example, you might map the redundancy groups as shown in Figure 6-17, Figure 6-18, Figure 6-19, and Figure 6-20.

Figure 6-17. Example Host LUN Mapping for Channel 0 of 1st Controller



Host LUN Mapping

Channel 0

Host LUN	Redundancy Group
0	0
1	1
2	2
3	3
4	-
5	-
6	-
7	-
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

Host LUN	Redundancy Group
16	-
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

Figure 6-17 shows LUNs 0 - 3 of host channel 0 mapped across the redundancy groups 0 - 3, whilst Figure 6-18 shows LUNs 0 - 3 of host channel 1 mapped across to redundancy groups 4 - 7.

Figure 6-18. Example Host LUN Mapping for Channel 1 of 1st Controller

Host LUN Mapping

Channel 1

Host LUN	Redundancy Group
0	4
1	5
2	6
3	7
4	-
5	-
6	-
7	-
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

Host LUN	Redundancy Group
16	-
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

Figure 6-19 shows the settings for the second controller which is a replica of channel 0 on the first controller.

Figure 6-19. Example Host LUN Mapping for Channel 0 of 2nd Controller

Host LUN Mapping

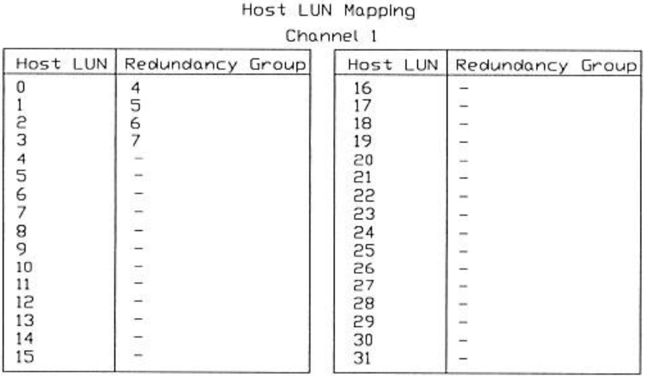
Channel 0

Host LUN	Redundancy Group
0	0
1	1
2	2
3	3
4	-
5	-
6	-
7	-
8	-
9	-
10	-
11	-
12	-
13	-
14	-
15	-

Host LUN	Redundancy Group
16	-
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

Figure 6-20 shows the setting for the second controller which is a replica of channel 1 on the first controller.

Figure 6-20. Example Host LUN Mapping for Channel 1 of 2nd Controller



Host LUN Mapping

Channel 1

Host LUN	Redundancy Group	Host LUN	Redundancy Group
0	4	16	-
1	5	17	-
2	6	18	-
3	7	19	-
4	-	20	-
5	-	21	-
6	-	22	-
7	-	23	-
8	-	24	-
9	-	25	-
10	-	26	-
11	-	27	-
12	-	28	-
13	-	29	-
14	-	30	-
15	-	31	-

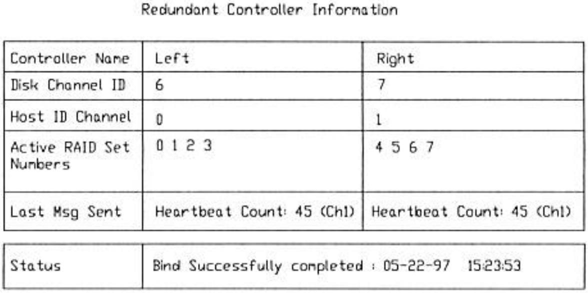
When finished, press Ctrlr-Z to return to the Main Menu.

Restart both controllers. The two controllers should automatically bind into a redundant controller set.

Viewing Controller Information

Select *System Information/Rdnt Ctrlr Information* from the main menu. The first controller should show a screen similar to that of Figure 6-21.

Figure 6-21. Viewing Controller Information from the 1st Controller



Redundant Controller Information

Controller Name	Left	Right
Disk Channel ID	6	7
Host ID Channel	0	1
Active RAID Set Numbers	0 1 2 3	4 5 6 7
Last Msg Sent	Heartbeat Count: 45 (Chl)	Heartbeat Count: 45 (Chl)

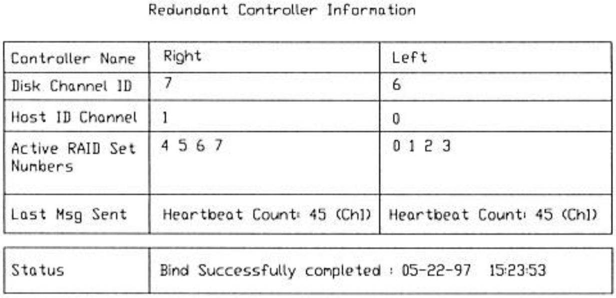
Status	Bind Successfully completed : 05-22-97 15:23:53

Figure 6-22 shows a screen shot for the second controller. Verify the following:

1. The STATUS field indicates that the bind was successfully completed.
2. The disk channel IDs and host I/O channels are separate and distinct for each controller.
3. Active RAID set numbers are not duplicated between the two controllers.
4. Heartbeat messages are being sent and received between the two controllers.

This concludes the configuration procedure for redundant controller mode operation.

Figure 6-22. Viewing Controller Information from the 2nd controller



Redundant Controller Information

Controller Name	Right	Left
Disk Channel ID	7	6
Host ID Channel	1	0
Active RAID Set Numbers	4 5 6 7	0 1 2 3
Last Msg Sent	Heartbeat Count: 45 (Ch1)	Heartbeat Count: 45 (Ch1)

Status	Bind Successfully completed : 05-22-97 15:23:53

Restart After Switchover

NOTE: If a failed controller is only being "power-cycled", perform steps 1 through 4. Then skip to steps 10 through 14.

1. Pause or stop all host I/O activity to the redundant controller sub-system.
2. Shut down the surviving controller (either from the Main Menu or the Front Panel). This is especially important to ensure that data in each cache is written to the disk. **If this step is not performed and the battery is removed, all data in the cache will be lost.**
3. Power off both controllers.
4. Remove battery power to both controllers. Ensure that enough time is allowed for the cache memory to fully discharge before continuing.
5. Swap the failed controller with another identical controller. The unit being swapped in must be configured in exactly the same way (same number and type of host and disk channel modules, same amount of cache memory, etc.).
6. Re-establish the system: reconnect the terminations, battery power connec-

tions, SCSI cables and the RCC cable.

7. Power on both controllers.
8. Reconfigure all controller parameters on the replacement unit for each sub-menu choice under *Setup Parameters* (i.e. *Host Parameters, System Parameters, Host LUN Mapping, Disk Parameters, Channel Settings* and *Redundant Controller Parameters*).
9. Shut down both controllers (either from the main menu or the front panel).
10. Power cycle both controllers.
11. Go to the *RAID Set Information* screen. Verify that all RAID sets are visible.
12. Verify that all controller parameters are correct on both units by checking each sub-menu choice under *Setup Parameters* (i.e. *Host Parameters, System Parameters, Host LUN Mapping, Disk Parameters, Channel Settings* and *Redundant Controller Parameters*).
13. Go to the *Redundant Controller Information* screen. Verify that the two controllers have successfully bound. Ensure that all RAID sets are active on the host channels of the correct controller (in accordance with the *Host LUN Mapping* and *Rdnt Ctrlr Parameters* settings on both controllers).
14. Resume host I/O activity to the redundant controller sub-system.

This concludes the procedure for Redundant Controller restart after swithover.

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Chapter 7: Front Panel Operation

The controller's front panel provides a means to get a quick glimpse of the status of your RAID sets. It also offers the capability to initiate rebuilds, and designate spare drives.

Main Menu

After the controller's start-up sequence, the front panel will display the manufacturer and model number of the controller. To enter the main menu, press the SEL button. You will see the following screen.

```
      Main Menu
   RAID SET STATUS
```

The main menu contains six items: *RAID Set Status, Shutdown Systems, Front Panel Tests, Rebuild Select, Rebuild Status,* and *Add Spare.* To toggle among the items, press the up and down arrow buttons. Press SEL to select a menu choice. Press EXIT to back out of a menu choice.

NOTE: You may shut off the controller's alarm from the front panel by pressing the up and down arrow buttons at the same time. You may disable the alarm from the monitor keyboard by pressing Ctrl-X.

RAID Set Status

If you select RAID Set Status, you will see a screen such as the following:

```
      RAID Set 0
  STATUS NONDEGRADED
```

The RAID Set Number is equivalent to the RAID Set Number displayed in the monitor utility. The status will indicate if the RAID set is DEGRADED, NON-DEGRADED, or UNUSED. Press the up and down arrow buttons to cycle through your redundancy groups. Press EXIT to return to the main menu.

Shutdown System

Use the Shutdown System command from the front panel when you wish to turn off the controller to move it or to perform maintenance on the system. The Shutdown System command ensures that any data in the controller's cache is written to disk before power down.

Front Panel Tests

This menu option takes you to a set of routines designed to configure the display and test the soundness of the front panel display and buttons. Use the arrow keys to spin through the tests. Press SEL to perform the selected test.

Set LCD Contrast

This option makes it possible to change the contrast of the front panel display. After you press SEL to select the option, press the up and down arrows to increase or decrease the display's contrast. You may hold a button down to quickly proceed up or down through the contrast range. Press EXIT when you have reached the desired contrast.

Alarm Test

Use this option to test the controller's alarm and Fault LED on the front panel. The up arrow button turns the alarm and LED on. The down arrow button shuts them off. When you are finished the test, press EXIT to return to the main menu.

Key Switch Test

This option enables you to test the front panel's buttons. When you have entered this test, the display will show the name of the button when you push it. When you press the EXIT button, "EXIT" will appear on the display, and after about four seconds, the display will return to the main menu.

Pixel Test

This test checks the soundness of the display. The up arrow button causes all the display's pixels to light up. The down arrow sends a regular binary pattern to the display.

Rebuild Select

This menu option permits you to initiate a RAID set rebuild with a disk that you select. If one or more degraded RAID sets exist when you select Rebuild Select, the controller will present you with a listing of all degraded RAID sets. They will appear one at a time in the front panel display, as shown in the following example:

```
-->RAID SET 1
   CHANNEL 2
    SCSI 1
DRVSTS RS01 MBR00
```

The first line of the four-row display indicates which degraded RAID set is currently selected. The second two lines should be considered as a pair. They form the address of the disk drive whose status is indicated in the bottom line. The fourth line indicates the status of the disk drive referred to by the channel and SCSI ID in lines two and three. A drive that is part of the RAID set will show up with the notation RSxx MBRyy, where xx is the RAID set number for the drive, and yy is the drive's member number within the RAID set. Any drive whose status is UNKNOWN, WARM SPARE, HOT SPARE, or EMPTY is a candidate for inclusion in the RAID set to be rebuilt. The arrow cursor indicates which row is active. When you press the up or down button on the front panel the value of the selected row will increase or decrease. Use the SEL button to move the cursor down a row, and the EXIT button to move back up to the top.

When you first select Rebuild Select, the arrow will be on the top row. By pressing the up and down buttons you can view each degraded RAID set. To proceed to the selection of a drive for inclusion in the rebuild, press the SEL button. This causes the arrow cursor to move to the second row, where you select the I/O channel of the drive to be included. Again, use the arrow buttons to spin through the available channel numbers. Once you have selected a channel, press the SEL button again to move the cursor to the SCSI ID row.

As you move through the channel and SCSI ID numbers, keep an eye on the bottom row and look for UNKNOWN drives, or HOT or WARM spares. These are the drives which you may select for the rebuild. If you have just installed a new drive, it may not have been recognized by the controller and will show up as EMPTY. You can select an EMPTY drive for the rebuild, in which case the controller will query the selected channel and SCSI ID to verify that a drive is present before initiating the rebuild.

Once you have found an available drive for the rebuild, press the SEL button to move the arrow cursor to the bottom line. Press the SEL button again to select the drive for the rebuild. The controller will ask you to confirm that you wish to proceed. Press the SEL button one more time to begin the rebuild. You may press the EXIT button at any time before the last SEL button push to abort the rebuild.

If you have other degraded RAID sets, you may repeat the preceding steps for each RAID set.

Rebuild Status

You may monitor the progress of a rebuild operation with the Rebuild Status menu option. Press the SEL button to select the Rebuild Status option. If a rebuild operation is underway, you will see a screen similar to the following:

```
   REBUILD STATUS
     RAID SET 0
      MEMBER 0
|XXXXXX     30%     |
```

If more that one rebuild is underway, you may selectively view the progress of each rebuild by pressing the up or down button. If you press the SEL button, the controller will display the status of each rebuild, switching to the next rebuild every two seconds.

Add Spare

The Add Spare option makes it possible to designate hot and warm spares from the front panel. To add a spare, press SEL when the Add Spare option appears in the front panel main menu. You will see a display somewhat like the following example:

```
--> Channel 6
    SCSI ID 0
DRV STS UNKNOWN
```

The arrow cursor indicates which row is active. Once a row is active, the arrow buttons cause the row's value to increase or decrease. The channel and SCSI ID uniquely identify each drive connected to the controller. Each time you change either the channel number or SCSI ID, the status of the specified drive will be displayed in the bottom row. You may designate any UNKNOWN drive as a spare, or change a hot spare to a warm spare or vice versa. Drives that you have installed recently will appear as EMPTY. If you designate an EMPTY drive as a spare, the controller will verify that the drive exists before making it a spare.

To complete the process of designating a drive as a spare, press SEL until the arrow is on the bottom line. Press the up or down arrow button until either HOT SPARE or WARM SPARE is selected. Then press SEL to save the selection.

```
    Channel 6
    SCSI ID 0
-->DRV STS HOT SPARE
```

Hot Spare

A hot spare is powered-up and spun-up at all times to be ready for action at a moment's notice. Since a hot spare is always spinning, it is subject to almost as much wear and tear as an active drive.

Warm Spare

A warm spare is powered-up at all times, but the controller will spin-up the drive only when it is needed to replace a failed drive. This slows the spare's response to a drive failure, but it reduces the chance that the spare will fail before it is called into action.

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Chapter 8: Battery Backup and UPS

WARNING: Before you install or upgrade a Voyager 5000 system you must read this. This section contains important information relating to the operation of your Voyager system. Failure to take note of the information contained in this section can lead to data corruption. If you have any further questions relating to the installation contact Eurologic Technical Support for assistance.

The Voyager 5000 ensures data integrity by two methods:

1. AC availability via an Uninterruptible Power Supply.
2. Battery backed up cache.

Uninterruptible Power Supply (UPS)

The UPS system will ensure data integrity by the use of two signals:

1. *Loss of AC Power.*
2. *Two minute battery reserve warning.*

Communication between the UPS and the controller is established by a UPS connector clearly marked at the rear of the controller shelf. If your system is a fault tolerant system you must have a UPS connected to each controller in the system. It is also possible to use a split serial cable to connect one UPS to both controllers.

When the AC Input to the UPS Fails

On receipt of the first signal the Voyager 5000 system will disable the write back cache function (if enabled), flush any pending write data from its cache and cause all Host issued writes to go directly to disk. The event *Loss of AC Power* will be flagged in the Voyager 5000 Event Log. The system will continue to function in this state until the AC input to the UPS is restored, or until the UPS reaches a state where the UPS battery has only a two minute reserve left.

When There is Only Two Minutes of UPS Reserve Power Left

On receipt of the two minute warning signal the Voyager 5000 will cause Host I/O activity to be blocked in preparation for the impending shutdown from the UPS and will update the Event Log.

Connecting to a Non Eurologic Supplied UPS

Eurologic supplies an UPS as standard equipment. Any user wishing to connect the Voyager 5000 to an UPS other than the Eurologic supplied one must ensure that a similar connection is made which will ensure the same degree of protection. The signals are active low and must conform to the pin out as given in Table 8-1. They are pulled up internally to +5 Volts and can be driven by a standard open collector driver or switch.

UPS Pin Contacts

The UPS supplied by Eurologic conforms to the AS/400 style LAN and has built in bypass protection. See Table 8-1 for detailed information.

Shutting Down the System

To shutdown the UPS first shutdown the RAID system by invoking the shutdown option from the *System Functions* Menu[1] and then shut down the UPS by pressing and holding the grey UPS Output OFF switch until the beep ceases which will take approximately three seconds. At this point unplug the UPS and after a period of approximately 20 seconds the UPS will shut down.

If in any doubt as to the suitability of a UPS contact Eurologic Technical Support for advice regarding KVA ratings and signal connections.

NOTE: You must enable the UPS option in the Setup Parameters/System Parameters Menu for correct UPS functionality.

---

[1] See the next section referring to shutting down the system for an extended period

Battery Backup

The battery backup is used to provide a further degree of protection from a failure which could result in DC Power supply failure to the controller. The cache is battery backed for protection. In the unlikely event of DC failure to the controller where an improper shutdown has been performed, the protection circuitry will enter a low current standby mode which preserves the contents of the cache memory for a limited time. When power is restored to the unit it will cause the contents of the cache to be safely flushed to the disk.

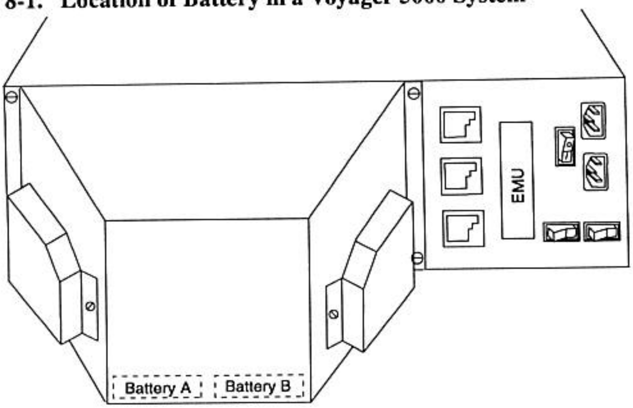
SIMMs and Battery Precautions

The battery constantly provides power to the cache circuitry and must therefore be **removed** if any SIMM modifications are to be performed. Failure to do so could lead to component damage.

Powering down the Voyager 5000 for Extended Periods

As the battery constantly supplies current to the cache circuitry, it is essential that the Voyager 5000 is not powered off for any extended period of time as this will cause the battery to discharge and will leave the system vulnerable until the battery has been recharged. If it is inevitable that the system must be shut down for an extended period then the battery power should be disconnected by gaining access to the Controller Shelf Backpanel and disconnecting the appropriate fuse as shown in Figure 8-1.

Figure 8-1. Location of Battery in a Voyager 5000 System



NOTE: Fuse type - 20 mm, T500mA (anti-surge).

In a single controller system only Battery A is installed (it is mounted behind the Controller Shelf I/O plate). When dual controllers are specified, then Battery B is installed as shown.

Battery Capacity

The battery supplied with the Voyager 5000 system is a 1.2 Ampere Hour 6 Volt battery. The charging circuitry in the Voyager 5000 is set to supply a current of 100 Milliamperes. Restoring a battery to a fully charged state can take up to a full day depending on the initial state of discharge.

Depending on the state of the battery charge and other conditions such as the age and environment a well charged battery is capable of retaining the memory contents for approximately four hours.

WARNING: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturers instructions.

UPS Connector Pin Assignments

The following table shows the UPS connector pin assignments of the Voyager 5000 as viewed externally.

Table 8-1 UPS Connector Pin Assignments - Voyager 5000

Signal	RJ11 Pin	Cable	Length	Header pin
Unused	1	26 AWG Blue	500mm	-
Low Battery	2	26 AWG Black	500mm	2
Unused	3	26 AWG Orange	500mm	-
Loss of AC	4	26 AWG Red	500mm	4
Unused	5	26 AWG Green	500mm	-
Ground	6	26 AWG White	500mm	6

NOTE: The cable shown is the internal cable from the Controller Shelf Backpanel to the controller.

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A

Accessing the Controller 2-3
Add Spare 7-4
Add Spare Drive 5-26
Advanced Cooling Modules 2-23
Alarm Test 7-2

B

Back Panel Connectors 2-8
Battery 2-9
Battery Backup 8-3
Battery Capacity 8-4
Bus Width 5-9

C

Cache Options 1-13, 2-14
Caching Parameters 5-13
Channel Settings 5-15
Chunk Size 5-24
Configuring Redundant Controller Operation 6-13
Controller Information 6-19
Controller Shelf 2-1, 2-2
Create Rate 5-11
Creating a RAID Set 5-21
Custom Components 1-16

D

Data Warehouse Models 1-3
Date 5-10
DC Power to Controllers 2-4
Design 1-14
Device Carrier 2-20
Disk Drives 2-12, 4-8
Disk Parameters 5-14, 6-14
Disk Shelf 2-1
Disk Utilities 5-30
Drive Info 5-22
Drive Selection 5-22
Dual Bus Configuration 4-10
Dual Host Active/Active 6-8
Dual Port/Dual Host Active/Active 6-9

E

Emulating a Monitor 5-1
Environmental Monitoring Unit 3-1
Environmental Status 5-19
Event Log 5-33
Event Type 5-35
Expansion 1-13

F

Failover Connector 2-10
Features 1-1
Format Disk 5-31
Free List Statistics 5-17
Front Panel 7-1
Front Panel Tests 7-2

H

High Availability 6-1
High Availability Requirements 6-1
High Availability Systems 1-8, 1-9
Host Cabling 4-8

Host Cards 1-13
Host LUN Mapping 5-13, 6-16
Host Modules 2-16
Host Parameters 5-8, 6-15
Host Select WCE 5-12
Hot Spare 5-27, 7-5
Hyper Terminal 5-1

I

I/O Process Information 5-20
I/O Statistics 5-17
I2C Connector 2-12
Installing SIMMs 2-15

K

Key Switch Test 7-2

L

LCD Contrast 7-2
LED Feedback 3-8
Load System Code 5-29

M

Main Menu 7-1
Manufacturing Information 5-18
Mega-Xfers/sec 5-9
Menu Tree 5-6
Monitor Utility 5-5
Multiple Host 4-20, 6-7

N

Non Eurologic Supplied UPS 8-2

O

Options 1-13
Options Board 2-22

P

Partitions 5-22
Password 5-10, 5-28
Pixel Test 7-3
Power Supply 2-19
Precautions 8-3

R

Rackmountable Models 1-4, 1-14, 4-1
RAID 0 1-18
RAID 1 1-19
RAID 5 1-23
RAID Information 5-7
RAID Set 5-22
RAID Set Functions 5-21
RAID Set Status 7-1
RCC Cable 6-3
Read -Ahead Limit 5-12
Read-Ahead 5-11
Rebuild Disk 5-25
Rebuild Rate 5-11
Rebuild Select 7-3
Rebuild Status 7-4
Rebuild/Create Status 5-32
Redundancy Group Number 5-24
Restart After Switchover 6-20
Restart System 5-30

S

SCSI ID 4-7
SCSI IDs 4-4, 5-8, 6-10
Serial Port 2-6
Shutdown System 7-2
Shutting Down 8-2
Single Bus Configuration 4-9
Single Host Active/Passive 6-7
Single-Host Active/Active 6-4
System Functions 5-28
System Information 5-16
System Parameters 5-10
System Power 2-8
System Shutdown 5-30

T

Tag Queuing 5-9
Temperature 4-2
Temperature Sensor 2-10
Term Power 2-9
Termination 4-8, 5-9
Test Port 2-14
Time 5-10
Transfer Mode 5-15
Transfer Rate Information 5-19

U

UART Connector 2-13
Uninterruptible Power Supply 2-10, 5-11, 8-1
Unpacking 4-1
UPS Connector Pin Assignments 8-5
UPS Pin Contacts 8-2

V

Validation Delay 5-12
Vision Software 1-14
VRA-5003DHA-XX-Y 1-9
VRA-5003D-XX-Y 1-5, 4-14
VRA-5005DHA-XX-Y 1-11
VRA-5005D-XX-Y 1-6, 4-16
VRA-5006DHA-XX-Y 1-12
VRA-5006D-XX-Y 1-7, 4-18

W

Warm Spare 5-27, 7-5
Warning Alarm 2-11, 2-14
Write Gathering 1-17
Write On Top 1-18
Write-Back Caching 1-17